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A National Environmental/Energy Workforce Assessment. Post-Secondary Education Profile: Summary

National Field Research Center, Inc, Iowa City, IA

Prepared for

Environmental Protection Agency, Washington, DC

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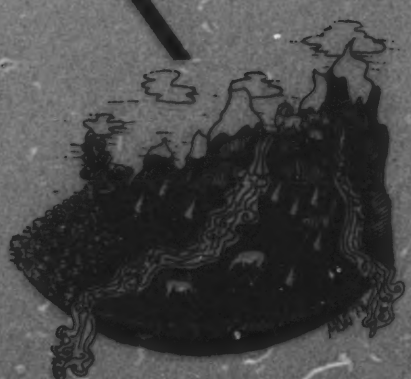
Post Secondary Education Profile

SUMMARY

Phase II
Of A National Environmental/Energy Workforce Assessment



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16. ABSTRACT This study is one of 16 volumes aggregating data on representative environmental education offerings in the United States at post-secondary education institutions and in the private sector of the economy. Structured around on-site interviews, the study describes the institutions' education programs — their program structure, representative course offerings, faculty structure, and program requirements. In addition, the study provides information on the employment history of graduates.

Designed as Phase II of a three-phase program, the study presents the information on schools in the following volumes: two volumes on potable water and two on wastewater; one volume each on air, noise, pesticides, radiation, solid waste and energy; a two-volume composite report on environmental engineering/health; a one-volume report on education/ecology; and a volume on some training programs conducted by businesses and by trade and professional associations. In addition, the study includes a one-volume abstract and a one-volume summary. The study is an overview. It doesn't include all environmental programs in the United States, and it makes no attempt to evaluate the program offerings.

Phase I of the study assessed the workforce needs (manpower needs) for pollution control and abatement in the United States for the five-year period of 1976 through 1981. Phase III, which will be available in September 1979, will offer recommendations, curriculum changes, and modifications that appear necessary to assure a properly trained national environmental workforce

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution Water Pollution Solid Wastes Potable Water Pesticides Radiation Noise Pollution Energy Manpower	Environmental Engineering Environmental Health Environmental Education Environmental Protection Pollution Control Instruction Schools Education Ecology	National Environmental/Energy Workforce Assessment	

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NATIONAL ENVIRONMENTAL/ENERGY WORKFORCE ASSESSMENT

PHASE II

POST-SECONDARY EDUCATION PROFILE

SUMMARY

Conducted by:

NATIONAL FIELD RESEARCH CENTER, INC.

Under Grant from:

UNITED STATES

ENVIRONMENTAL PROTECTION AGENCY

Grant #T900591

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Appreciation is extended to the many individuals, institutions, and organizations who generously contributed to the success of this national project. Of particular import are those contact persons listed in the program summaries. Their time and assistance in preparation, input and review represents the foundation upon which the National Environmental/Energy Workforce Assessment - Phase II rests.

Sincere appreciation is expressed to those persons within the United States Environmental Protection Agency, Office of Federal Activities, who provided guidance and direction throughout the term of the project: Mr. J. Donald Cook, Project Officer; Mr. Joseph McCabe, and Mr. Michael Moore.

Gratitude must be expressed to the many individuals and organizations from the private sector who were most generous in their contribution to this project. Their openness and responsiveness reflect their concern regarding the training of our environmental workforce and their critical role in that effort.

FOREWORD

Information for this report was largely compiled from on-site interviews with professionals in post-secondary institutions throughout the United States. On-site interviews were supplemented by telephone and/or mail contact to clarify and revalidate the data. This report presents a summary of programs in junior colleges, vocational/technical training institutes, community colleges, four-year colleges, and universities as well as other training institutions. Programs are representative of all levels from academic certification through doctoral degrees. The environmental pollution control areas of air, noise, pesticides, potable water, radiation, solid waste, wastewater and energy were surveyed.

This study was conducted for the United States Environmental Protection Agency by the National Field Research Center, Inc. of Iowa City, Iowa, with field offices located in Atlanta, Georgia; Denver, Colorado; and Washington, D.C.

PROJECT BACKGROUND

Photo reprinted from the University of Wisconsin, Madison Oceanography and Limnology Catalog

PROJECT BACKGROUND

OVERVIEW:

In late 1975, Congress acknowledged the growing national concern for the preservation and conservation of our national resources with a direct inquiry into the availability and readiness of our environmental workforce. That inquiry has taken the form of a three-year, three-phase National Environmental/Energy Workforce Assessment, currently being conducted by National Field Research Center under the direction of the U.S. Environmental Protection Agency. In keeping with the objective of the assessment, this three-phase national effort directs itself at environmental/energy workforce needs, national educational preparedness, and the functional relationship between the two.

PHASE I:

Phase I of the National Environmental/Energy Workforce Assessment focused upon the development of "workforce demand projections" through 1982 for all public environmental agencies. This on-site assessment, which was carried out in all 50 states, Puerto Rico and the Virgin Islands, culminated in a numerical profile of the growth patterns and workforce needs at the national and state levels. Stratification of the overall definition of "environmental occupation" into seven distinct vocational areas enhanced even further the applicability of the results. In addition to this public sector workforce assessment, Phase I included an overview analysis of private sector needs (through an adjunct mail

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survey of selected businesses and industries) and a brief review of selected environmental educational programs.

Phase I was completed in May, 1977. The 70-volume final report included:

* National Abstract	(1)
* National Legislation	(1)
* Regional Assessments	(10)
* State Assessments (including D.C., VI and PR)	(53)
* Business and Industry Assessment	(1)
* National Summary	(4)

PHASE II:

Phase II of the National Environmental/Energy Workforce Assessment was structured around an intensive on-site inventory of representative environmental educational offerings on a national scale. The primary objective of this project has been to collect and aggregate data on training and educational programs in both the post-secondary education field and in the private sector and to do so by environmental area. Specifically, the study was designed to provide an overview of environmentally related post-secondary education programs, their program structure, representative course offerings, employment history of the graduates, and the faculty structure. Additionally, information was to be collected on program requirements and program projections.

Initially, opportunities to nominate programs for inclusion in this on-site review process was given to the Environmental Protection Agency and its program officers and regional personnel both through the

Project Officer and via direct mail requests; all state departments of education; state environmental agencies and selected media-specific associations. These nominations were supplemented by a direct review of institutional catalogs, information obtained during the first year's on-site activities, and a review of other published sources of information regarding degree programs in environmental areas.

Following their initial development, the lists of nominees were forwarded to the program officers for suggestions regarding additions or deletions. Next, letters were written to those nominated institutions seeking their support and cooperation in the on-site review process. Several programs, some of which were highly recommended, declined the opportunity to participate giving reasons varying from lack of time to the fact that the program being inquired about no longer existed, to outright refusal to cooperate with any government study. These institutions were deleted from the final on-site process. The remainder were included in the study and are shown in Table 1 of each volume. Selection of the sample for the private sector is discussed in depth in that particular volume.

In preparation for the on-site interviews, appropriate persons were contacted in the institution involved and were given a background description of the study, a suggested timetable for the interview process and were told what kind of information was being sought. This was all done in an effort to keep the time involvement of the individual contact persons at a minimum. During the actual on-site interview, generally lasting around one hour, the information was collected, questions asked and answered, and further informational contacts identified. Following

this process, each on-site interview was written up in the form of a Training Program Summary, which where time allowed, was returned to the contact person for critiquing prior to inclusion in the report.

Throughout this process, individuals and institutions were given assurance that this study was not an attempt to evaluate program offerings and every attempt has been made on the part of the writers to live up to this assurance. Inclusion in this report provides no assurances of quality, nor should a program's exclusion be consideration of the lack thereof. In many instances certain programs within an institution were not included while others were, primarily due to the determination of the sample - previously discussed. This too should not be viewed in any qualitative manner.

REPORT ORGANIZATION:

The final report, of which this volume is a part, consists of volumes depicting a training profile in each medium under consideration, namely,

Air
Energy
Noise
Pesticides
Potable Water
Radiation
Solid Waste
Wastewater
Composite
Business and Industry and Trade Associations

At the outset it should be pointed out that there are very few degree programs conveying degrees in a particular medium; rather, degrees are offered in various specialties which lend themselves to

obtaining employment in one or more of these fields. Nonetheless, to obtain maximum utility for the funding agency, programs were reported in this fashion. The Composite section was necessitated by the number of programs offering course work in multiple fields and differing specializations resulting from course selection. For convenience in handling of the data Potable Water, Wastewater and Composite have been reported in multiple volumes because of the numbers involved. Although separated into volumes either by degree level of the programs involved, as in the case of Potable Water and Wastewater, or by content as in the case of Composite, persons interested in any of these fields would be well advised to review each of the volumes to assure more complete coverage.

Along with the standard introductory pages common to volumes of this nature, each volume contains sections on Project Background, Introduction (consisting of sections devoted to a description of the programs surveyed and covered in the volume), Project Commentary, and the Training Summaries along with the Appendices.

REVIEW PROCESS:

In addition to individual training summary reviews conducted by the persons initially interviewed, each volume has been reviewed internally, by persons in the Environmental Protection Agency and by a select group of review committee members. In the final instance, individuals met during the on-site process were nominated by interviewers for inclusion on the review committee, primarily as a result of their obvious expertise in the field and their evidenced interest in the project.

These persons were then contacted by mail or by telephone in an effort to determine their willingness to serve. The rather stringent timelines necessary to keep the project on course and to deliver the finished product as specified were also detailed. In excess of one hundred persons returned their volumes (out of a mailing of 120) and all but five of these provided usable responses. In these five instances either last minute job demands prevented them from carrying out the review in the short timelines, or (in two instances) individuals indicated that they wanted nothing to do with the process. This particular method of review provided a wealth of valuable information, suggestions for revision of specific elements, and general comments helpful in revising the final documents. In all cases an effort was made to seriously consider and incorporate reviewer suggestions. The persons on the various review committees are individually acknowledged in the front of the volume they reviewed.

Photo reprinted from the University of Missouri, Columbia Bulletin 1977.

INTRODUCTION

Photo reprinted from the Northland College Catalog 1975-76

INTRODUCTION

This volume contains a 6-10 page summary for each of the eight environmental areas studied during the National Environmental/Energy Workforce Assessment (Phase II) - Post Secondary Education Profile. Also included is a summary for the two volumes dealing with the composite section of this report (environmental engineering/health and education/ecology). The concluding summary deals with business and industry and trade and professional organizations.

No attempt was made by the project staff to visit every state which offered a program in each environmental area. Nor was an attempt made to visit all programs at a particular institution. The reader is referred to each specific volume for a more detailed discussion of the area under his/her consideration. They are:

AREA	NUMBER OF VOLUMES
Air	1
Energy	1
Noise	1
Pesticides	1
Potable Water	2
Radiation	1
Solid Waste	1
Wastewater	2
Composite	3
Private Sector	1
Summary	1
Abstract	1

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SUMMARY

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A. STATES, INSTITUTIONS, PROGRAMS AND DEGREES

Forty five institutions located in 25 states were chosen for on-site visits. They are representative samples of air training programs available in the United States. Fifty programs are described in the program summaries section of the air volume; 48 at the various institutions and two non-degree programs (U.S. Environmental Protection Agency at Research Triangle Park, North Carolina and the Air Pollution Control Association in Pittsburgh, Pennsylvania).

Degrees offered by the 45 institutions varied from minor to a doctoral. Table 1 shows the number of programs that were surveyed by degree and states visited.

TABLE 1

AIR DEGREES, PROGRAMS AND STATES

Degrees	Number of Programs	States	
Minor	1	Connecticut	North Carolina
Certificate	1	Delaware	North Dakota
Associate	8	Florida	Ohio
Bachelors	2	Illinois	Oregon
Masters	11	Indiana	Pennsylvania
Environmental Engineer	1	Iowa	South Carolina
Multiple Degree		Kentucky	Tennessee
Certificate/Associate	1	Maryland	Texas
Bachelors/Masters	1	Massachusetts	Virginia
Bachelors/Masters/PhD	6	Michigan	Washington
Masters/Engineer/PhD	1	Missouri	Wisconsin
Masters/PhD	15	New Jersey	West Virginia
		New York	
TOTAL	48	25	

B. ENROLLMENT STATISTICS AND GRADUATES

Techniques for the recruitment of students depends upon the institution. Methods that have proven to be very helpful include: alumni publications, articles in professional journals, mass mailings, open house, recommendation by a graduate, visits to area high schools.

Graduate level training (Masters & Ph.D.) had more out-of-state students than are found in the associate and bachelor programs. In part, this can be attributed to more funding being available to students and to the fact that fewer institutions offer advanced training. Thirty-three percent of the programs (16 of 48) mentioned students of foreign origin being enrolled in their programs.

Almost half (25 of 48) of the programs had an organized and, in many cases, a yearly method in which they maintain contact with their graduates.

The nationwide trend is that more students are enrolled in the Masters program both as full-time and as part-time students. Thus, it follows that Masters programs have the largest number of graduates.

Table 2 is the national enrollment profile and summarizes the apparent enrollment trends by degree over the past three years.

TABLE 2

AIR ENROLLMENT PROFILE SUMMARY

Degree	Enrollment Full-time	Enrollment Part-time	Graduates Average # Per Year	Graduate Change By Program Up	Down	Stable
Associate	152	8	66	2	5	2
Bachelors	639	15	182	5	0	4
Masters	912	618	424	10	3	21
Engineer	3	0	2	0	0	1
Doctoral	119	28	37	3	2	18
TOTAL	1,825	669	711	20	10	46

C. FACULTY

Numbers of full and part-time faculty were determined by the individual institutions. Because there is some duplication of programs (i.e., a write-up appearing in more than one volume), it would be misleading to assume that the 531 full-time and 1,655 part-time faculty, associated with the 48 programs teach only air courses. Rather they have a variety of environmental courses to conduct.

D. CURRICULA

An internship/applied study term is an option for obtaining a degree at some institutions. It varies in length and may or may not include financial reimbursement. It has been cited as the distinguishing characteristic of a program. Nineteen of the 48 programs had such an option available.

In 46 percent of the programs visited, implementation of a course took between one month and one year. A program took the same amount of time with a slightly higher percentage (50%) responding affirmatively.

In response to a commonly leveled criticism that students trained in the environmental areas are weak in written and oral communication and financial management skills, contact people were asked how their institution responded to this need. Methods most often mentioned for remediation were: summer practicum, requiring a speech course, incorporating technical writing skills into present course structure, requiring basic management skill courses.

E. RESEARCH FUNDING AND SOURCES OF STUDENT FINANCIAL SUPPORT

Most of the 45 institutions surveyed were receiving or had received public and/or private monies for research. It varies with faculty interest, teaching load and amount of clerical help supplied how much outside funding is connected with a specific program.

Great concern was expressed at the withdrawal of EPA funds for air research and the student support that often resulted. As a result of the reduction of grants available, enrollment in these programs are on the decline.

F. EMPLOYMENT

Employment statistics were gathered from contact people and are the results of formal follow-up studies or estimates. They

describe the workforce entry positions of graduates of these programs. Table 3 shows the combined result of the 48 air training programs visited.

TABLE 3

AIR EMPLOYMENT PROFILE SUMMARY

Degree	Private Sector Industry	Consulting	Combined	Government	Other
Associate	18%	17%	35%	30%	35%
Bachelors	36%	38%	74%	22%	4%
Masters	28%	29%	57%	37%	6%
Engineer	-	50%	50%	35%	15%
Doctoral	31%	29%	60%	36%	4%

Contact people were asked to enumerate occupations that they felt their graduates were qualified to fill. Mentioned most often were:

Degree Level	
Associate	Air Pollution Control Inspector Air Pollution Control Technician Pollution Control Specialist
Bachelor	Air Pollution Control Engineer Air Pollution Control Inspector Environmental Control Technologist
Masters	Air Pollution Control Engineer Air Pollution Control Supervisor Chemist
Doctoral	Air Pollution Control Chemist Air Pollution Control Engineer Sanitary Engineer

ENERGY SUMMARY

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ENERGY

A. STATES, INSTITUTIONS, PROGRAMS AND DEGREES

Energy education programs offered by more than 30 schools in eighteen states were surveyed in Phase II. Because several schools offer more than one program, the report includes in excess of 40 programs in which 95 certificate or degree sequences are available.

Table 4 depicts the number of programs surveyed by degree.

TABLE 4

ENERGY DEGREES, PROGRAMS AND STATES

Degree	Number of Programs	States
Certificate	4	California
Associate	6	Connecticut
Bachelors	1	Florida
Multiple Degree Programs		Georgia
Associate/Bachelors	2	Indiana
Bachelors/Masters	2	Kansas
Associate/Bachelors/Masters/ Doctorate	1	Kentucky
Bachelors/Masters/Doctorate	11	Massachusetts
Masters/Doctorate	2	New Jersey
Non-Degree Programs	2	New Mexico
		New York
		Ohio
		Oregon
		Pennsylvania
		Tennessee
		Texas
		Utah
		West Virginia
TOTAL	31	18

B. ENROLLMENT STATISTICS AND GRADUATES

Only one program respondent said recruitment is a major problem. Most replied that their efforts are adequate; several said that the program is involved in no active recruitment because student demand is high in response to high paying jobs awaiting graduates. Those who do recruit rely heavily upon brochures, university-wide recruiting efforts, and word-of-mouth among collegues and students.

Among the associate degree programs, 80 to 100% of the students are in-state. Among the bachelors programs, most range from 70-80% in-state; the high is 98%, the low, 33%. Masters and doctoral enrollments range from a high of 75% to a low of 20% in-state; most have fewer than 50% in-state.

The energy programs in the sample are extremely diverse; few characteristics are held in common throughout. Enrollments vary from fewer than 10 to more than 600. Nearly 60% of the students are in bachelors programs; of these, 99.5 are full-time. Associate degree programs account for slightly more than 25% of all students; 13% are enrolled in masters programs; and little more than 3% are in doctoral programs. Fewer than 5% of the students in energy education programs surveyed are women.

Few programs have graduate follow-up information beyond entry level. Many who replied in the affirmative to graduate follow-up indicated it is on an informal basis.

Table 5 presents the Energy Enrollment Profile Summary for the programs surveyed:

TABLE 5

ENERGY ENROLLMENT PROFILE SUMMARY

Degree	Enrollment Part-time/Full-time		Graduates Average # Per Year	Graduate Change by Program Up/Down/Stable		
Associate	774	265	260	6	3	1
Bachelors	2,540	19	503	11	0	7*
Masters	503	199*	211	15	0	12
Doctoral	171	24	39	3	0	11
Graduate[1]	165	0	70	3	0	0
Certificate (Master's level)	6	50	30	1	0	0
TOTAL	4,159	557	1,113	39	3	31

* Complete figures are not available.

[1] No breakdown among graduate students is available for some programs.

C. FACULTY

Altogether, 231 (58%) full-time program faculty and 165 (42%) part-time (home-based in other departments) were recorded. Approximately half the programs rely exclusively or nearly so on full-time program personnel; several programs are made up of a core program faculty supplemented by several people cost-centered in other departments. Several multidisciplinary efforts are staffed by one person with coordinating responsibilities and a large number of faculty whose program participation may vary from active participation in administration, student advising, and curriculum decisions to assuming responsibility for teaching a single course infrequently.

No meaningful student-faculty ratio can be developed due to the variance in method of program staffing and differences in teaching loads and research commitments.

D. CURRICULA

Programs in the report include well-established programs in nuclear engineering, and mining petroleum and natural gas technology and engineering. Additionally there are unusual programs in energy conversion, energy resources managment, and several others which represent recent innovative approaches to a broad spectrum of energy problems.

Several programs indicated internships or applied study terms are an integral component of the educational experience. Seven of the associate programs either require or contain an active option of internships; 13 of the bachelors programs do so, as do nine of the masters programs. It is an option in a few doctoral programs. Several respondents singled out the applied study aspect as the most important component distinguishing their program from similar efforts.

Respondents were asked to indicate the normal time frame in which a change in a course or program sequence can be implemented. The time factor of program flexibility so indicated by energy programs is typical of most academic areas. Most course changes can be implemented within one year (usually for the succeeding term), although six programs noted more than a year is required. Program sequence changes, for the most part, take longer, but most are accomplished within a year. Faculty noted that it is an easier process to change curriculum at the graduate level than at the undergraduate level.

The need for additional curriculum materials appears to be of little concern except at the associate level. Faculty complained both of materials that are above and below the reading or technical level of associate degree students.

Respondents representing engineering programs often replied that communication skills are a problem of incoming students; there is some disagreement as to how well the problem is dealt with. Associate program faculty felt the level of communication skills of many of their students is a problem of major significance.

E. RESEARCH FUNDING AND SOURCES OF STUDENT FINANCIAL SUPPORT

Energy research support is widespread. As would be expected, the U.S. Department of Energy is the most prevalent source of research money. Other federal sources most commonly cited were the U.S. Bureau of Mines; the Environmental Protection Agency; Health, Education and Welfare; and the Nuclear Regulatory Commission. Many state agencies support projects. The National Science Foundation and the Ford Foundation provide much support, as do many industries, especially through institute contributions such as the Electric Power Research Institute and the American Iron and Steel Institute. Oil and gas companies and utilities contribute significantly.

Research and teaching assistantships are available in most graduate programs. Many student jobs are supported through research funding. Scholarships, fellowships, and student loans are readily available; work-study programs are common for undergraduates.

Engineering students are often eligible for a cooperative work program. Many students have industry grant support, often in the form of a traineeship.

F. EMPLOYMENT

Table 6 presents employment data for graduates of the energy education programs surveyed in Phase II. Figures were provided by faculty

members and are either "best estimates" or actual statistics gathered.

TABLE 6

ENERGY EMPLOYMENT PROFILE SUMMARY

DEGREE	PRIVATE SECTOR Industry/Combined*/Consulting			GOVERNMENT	OTHER
Certificate	50%	-	45%	5%	-
Associate	81%	8%	-	7%	4%
Bachelors	56%	8%	12%	18%	6%
Masters	55%	8%	9%	26%	2%
Nuclear Engineer	64%	-	-	18%	18%
Doctoral	21%	3%	9%	38%	29%
Graduate[1]	-	-	52%	48%	-

[1]Some programs were unable to break out Masters and Doctoral students.
*Some programs were unable to break private sector employment into separate categories of industry/consulting.

Respondents were provided a list of energy occupations. They were asked to indicate those occupations for which their graduates are prepared and to add appropriate positions to the list.

The occupations most cited were:

Degree Level	Occupations
Associate	Entry Level Miner (coal) Petroleum Engineer Technician Radio-Chemistry Technician
Bachelors	Chemical Engineer Energy Engineer Mining Engineer Nuclear Engineer Environmental Control Technologist Petroleum Geologist Technician
Graduate	Environmental Physicist Mechanical Engineer (Conversion) Energy Policy Analyst Electric Power Engineer

NOISE SUMMARY

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NOISE

A. STATES, INSTITUTIONS, PROGRAMS AND DEGREES

Noise related training programs were reviewed in nine degree-granting institutions in seven states. Only one of these offers the option for pursuing a bachelor's degree. One program in acoustical engineering offers the opportunity for students to complete one of several traditional engineering degrees, while taking courses which have direct application to acoustical engineering. The remaining seven programs offer advanced degrees, all but one at both the master's and doctoral levels.

Six of the programs are conducted by engineering disciplines, with one other being from an engineering perspective, but through a non-engineering department. One program in industrial audiology is starting this year, and is one of the two audiology programs surveyed. Two other programs which do not offer academic degrees are also included in the profile.

The following table illustrates the geographic spread of the degree-granting programs reviewed for this profile.

TABLE 7

NOISE DEGREES, PROGRAMS AND STATES

Degree	Number of Programs	States
Bachelors	1	Georgia Massachusetts North Carolina Ohio Pennsylvania Tennessee Virginia
Masters	8	
Doctoral	7	
Certificate (Advanced)	1	
TOTAL	17	7

B. ENROLLMENT STATISTICS AND GRADUATES

Only one of the noise programs surveyed for Phase II reported no need for formalized recruitment. The remainder of them advertise in a variety of ways; most commonly employed is the distritution of descriptive materials (e.g., brochures, posters, etc.) on campus as well as in other institutions. Other methods of student recruitment include distributing program requirements among related majors' students, faculty members' visits to other institutions, and maintaining high visibility at national meetings and conferences.

Table 8 depicts the enrollment profile and average number of graduates by degree level for the past three years. Also summarized in this table are the apparent enrollment trends by degree, over the past three years.

TABLE 8

NOISE ENROLLMENT PROFILE SUMMARY*

Degree	Enrollment Full-time / Part-time		Graduates Average # Per Year	Graduate Change By Program Up / Down / Stable		
Bachelors	30	-	30	1	0	0
Masters	84	17	38	3	0	6
Doctoral	50	7	13	3	0	4
TOTAL	164	24	81	7		10

*The reader should be aware that neither the University of Tennessee's Industrial Audiology program, nor the Georgia Institute of Technology's Acoustical Engineering program were able to provide enrollment data. In addition, each degree level is recorded as one response in the enrollment trend.

Statistics show that in-state enrollment figures predominate, ranging from 60 to 80 percent attendance from within the state. While the percentage of women enrolled varies from one institution to another, the average is around 15 percent for these programs.

C. FACULTY

Noise programs which are described in the profile are served by a total of sixty-nine full-time faculty and eighty-eight part-time faculty. These faculty have varying levels of interaction with those programs which are classified as noise-related, and many of those which have been called part-time may have full-time status in another department. Responsibilities vary among administration, research, and teaching.

D. CURRICULA

Six of the programs surveyed are associated with, or located within engineering departments (in several cases, these departments cooperate with various non-engineering departments in offering the programs). A seventh program is housed in a department of industrial environmental health sciences, but offers a strong engineering emphasis. All of these programs focus on acoustics, noise and vibration control. The remaining two programs offer degrees in audiology, one specifically in industrial audiology. The two non-degree granting programs summarized in the profile include one, by the University of Tennessee Center for Health Sciences, which offers courses in audiometric orientation for industrial hearing conservationists. The second consists of a number of courses specific to noise which are offered

by a state agency, the Florida Department of Environmental Regulation.

Four of the degree programs include an applied study term as an integral part of the curriculum. Two of these are audiology programs which require a clinical practicum as a part of clinical certification (ASHA) requirements. The emerging University of Tennessee Industrial Audiology program will require students to complete a portion of the practicum in an industrial setting. The Pennsylvania State University and George Washington University also offer their students applied study opportunities.

It was believed that by finding out the time frame for making changes in a course and in a program, a useful reference with regard to procedural, administrative, and developmental constraints would result. In most of the cases where respondents were able to affix a figure to such changes, it was found that a course can be changed in from less than one month's time to one year's time. A program change requires a more complex procedure, and while over half of those who were able to respond report similar time frames as for course changes, nearly as many report that program changes require between one to two years to effect.

Curriculum materials which were felt to be lacking include texts in both acoustics and audiology, a "good acoustics textbook", for example. Emphasized also was the need for a thorough treatment of noise control engineering.

E. RESEARCH FUNDING AND SOURCES OF STUDENT FINANCIAL SUPPORT

Research assistantships are by far the most widely utilized form of financial aid to graduate students. Funding is often channeled

through the respective Graduate Schools, or an established noise-related center research body. One official reports that Ph.D. candidates are occasionally employed as research associates. Most programs offer a limited number of scholarships, which are awarded on a competitive basis. Several sources feel that while they have no knowledge of federal training grant monies for any level of student, there is a need and justification for these monies.

Research funding comes from grants and contracts from both public and private organizations. Federal agencies most often mentioned as providing support are the U.S. Navy, the Occupational Safety and Health Administration - NIOSH, the National Aeronautics and Space Administration, the U.S. Army, the Department of Transportation, and the National Science Foundation. Private industries which have provided support include Allied Chemical Company, Tennessee Eastman Kodak, Kingsport Press, Arcada National Press, Mead Johnson, Pease Company, General Electric Corporation, and Burlington Industries.

F. EMPLOYMENT

Table 9 provides employment data, describing the workforce entry positions of graduates of these programs. The categories are broadly defined as 'industry', 'consulting', 'combined', 'government', and 'other'. 'Combined' refers to those figures which when provided to researchers could not be broken down into the categories of 'industry' or 'consulting'. Figures were provided by faculty members, and were either taken from actual follow-up study data or were "best estimates".

TABLE 9

NOISE EMPLOYMENT PROFILE - SUMMARY

Degree	Private Sector Industry/Consulting/Combined			Total Private	Government	Other
Bachelor	75%	10%	-	85%	10%	5%
Masters	16%	4%	32%	52%	40%	8%
Doctoral	15%	5%	29%	49%	33%	18%

A list of occupational titles was sent to contact persons which requested that they correlate the appropriate title with the qualifications of their graduates (with specific notation of academic level).

According to sources, Bachelor students who have completed a course sequence in noise are qualified to fill the noise related occupations of: Acoustical Engineer, Noise Control Specialist, and Industrial Engineer. Masters and doctoral graduates in acoustic/noise control are qualified to enter the above occupations, as well as those of Noise and Vibration Control Engineering, and Noise Control Consultant. Those completing a doctoral degree may also be qualified for the occupations of acoustical physicist. Graduates of the audiology programs may enter the noise related occupations of Industrial Audiologist and Occupational Hearing Conservationist. Nearly all of the officials interviewed believe that the future demands for noise control professionals will increase but the lack of regulatory legislation and the paucity of funds will hinder the meeting of these needs.

PESTICIDES SUMMARY

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PESTICIDES

A. STATES, INSTITUTIONS, PROGRAMS AND DEGREES

Pesticide-and toxicology-related training programs were reviewed in 20 states and in 26 academic institutions. Three programs included in the study were considered non-institutional and are not degree-granting. Considerable variance in size, description, and extent of topic coverage was observed. The 34 programs surveyed range from the certificate and diploma level to advanced degree programs; they are offered by institutions such as community colleges, private colleges, and state universities. Table 10 illustrates the breadth of geographic coverage represented in this profile. A number of options are offered at more than one academic level, which allows a student to pursue those topics to whatever extent she/he chooses.

TABLE 10

PESTICIDES DEGREES, PROGRAMS AND STATES

Degree	Number of Programs	States	
Associate	4	California	New Hampshire
Bachelor	8	Delaware	New Jersey
Masters	5	Florida	New Mexico
Doctoral	2	Georgia	New York
Multiple Degree Programs		Iowa	North Carolina
Certificate/Associate	2	Louisiana	Ohio
Bachelor/Masters	1	Maryland	Oregon
Bachelor/Masters/Doctoral	4	Massachusetts	Pennsylvania
Masters/Doctoral	5	Mississippi	Utah
		Nebraska	Texas
TOTAL	31	20	

The three remaining non-institutional programs are offered in Maine, Florida, and Nebraska, and none offers any form of academic credit.

B. ENROLLMENT STATISTICS AND GRADUATES

Although a number of pesticide/toxicology programs report they have no need for formalized recruitment, the majority employ one or several techniques. Examples of such include: forwarding descriptive materials to other institutions, making personal responses to prospective students' inquiries, making contacts at national meetings and in industrial settings, and maintaining registry in the Peterson's Guide to American Colleges and Universities.

Statistics show a high of 95 percent of the associate level entrants' coming from within the state, as compared to a low of 41 percent at the doctoral level. The percentage of women enrolled in these programs varies at all levels from 11 to 50 percent.

Tables 11 and 12 depict the enrollment profiles and average number of graduates for the past three years, by degree level, for pesticide and toxicology programs respectively, which were reviewed for Phase II. Also summarized are the apparent enrollment trends by degree, over the past three years.

TABLE 11

PESTICIDE ENROLLMENT PROFILE SUMMARY

Degree	Enrollment Full-time	/ Part-time	Graduates Average # Per Year	Graduate Change by Program Up	/ Down	/ Stable
Associate	147	1	46	1	0	6
Bachelor	374	11	107	7	0	5
Masters	236	4	51	5	0	6
Doctoral	71	0	11	2	0	3
TOTAL	828	16	215	15	0	20

TABLE 12

TOXICOLOGY ENROLLMENT PROFILE SUMMARY

Degree	Enrollment Full-time	Enrollment Part-time	Graduates Average # Per Year	Enrollment Change by Program Up	Down	Stable
Associate	0	0	0	0	0	0
Bachelors	42	0	22	0	0	1
Masters	43	1	18*	1	0	0
Doctorate	72	0	14*	3	0	2
TOTAL	157	1	54*	4	0	3

*Estimated graduate figures

C. FACULTY

Pesticide and toxicology programs which are described in this profile are served by a total of 620 full- and part-time faculty. Fifty-nine percent, or 369 of these, are part-time and the remaining 40 percent have full-time involvement. Even though faculty responsibilities may vary in substance and extent among teaching, research, and administration, it is useful to compare the total faculty support to the total number of students counted for full-time enrollment, i.e., 926 students.

Pesticide/toxicology program officials responded to the question, "How do you keep current in your field?" most often by identifying affiliations with professional associations, including participation in their regional and national meetings and conferences. Other means of keeping abreast of the field include: carrying out research, reading current professional papers and other relevant literature (including

journals), keeping contact with colleagues at other institutions, teaching courses, consulting, and working in agricultural extension services.

D. CURRICULA

The pesticides certificate/associate programs focus on pest control technology, and represent several approaches to the field, including agricultural pest control, urban pests management and plant protection. Bachelor level programs are nearly evenly divided between the classifications of entomology and pest management. Graduate curricula surveyed are also predominantly classified as entomology and pest management programs, though offering more advanced and specialized courses. Of the seven toxicology programs surveyed, one is offered at the bachelor level, with a concentration in environmental toxicology. The remaining six toxicology programs are offered at the graduate level, and within the majority of these programs, the student has a choice of concentrations (i.e., environmental toxicology, neuro-behavioral toxicology, or radiation toxicology).

In some cases, students are able to receive on-the-job training through a co-op program. An internship/applied study term is available in twelve of the thirty-four programs visited.

Faculty members were asked to identify time constraints which apply to making changes in a single course, as well as the time necessary to implement a change in a program. Courses are commonly added under the title of "Special Problems" or "Special Topics" until they are channeled through the appropriate ranks for approval and inclusion in the catalog. The date of catalog

publication often determines how quickly both course and program changes may take place. Still another built-in feature of many programs is that of the "individualized program", wherein an institution may informally offer students a number of unconventional options. Most faculty responses show that changes in both courses and in programs require from one month to one year to establish officially.

There is a need to develop curriculum aids such as micro-films, audio-visual materials, and tutorial/self-help materials. Another need which was noted was for text materials designed for the intermediate level. It is felt that most existing materials are prepared with either the advanced level class or the very basic class in mind.

With only one exception, the communication skills of pesticide/toxicology students are considered to be deficient. One cause which was cited was a lack of practical experience in writing, so remediation in that institution is taking the form of extensive report writing assignments and essay type examinations. It was thought also that such measures as increasing the time required for earning a bachelor's degree from four to five years, developing and alliance with industry to secure their assistance in identifying graduates' skill priorities, and requiring students to take courses in technical writing all would be helpful in remediation. The responses which were recorded for the question of students' financial management skills were like those regarding communication skills, but much less emphatic. One source felt the quantified/scientific nature of these fields cause these math related skills to be sufficient, if not somewhat enhanced.

E. RESEARCH FUNDING AND SOURCES OF STUDENT FINANCIAL SUPPORT

Data from Phase II indicate that the most prevelent form of financial assistance to graduate students is the research assistantship, and similar in-house work-study arrangements. The funding is often channeled through the respective graduate schools, or an established center or research body. At the undergraduate level the nature of and availability of financial support is influential on the percentage of students who attend an out-of-state insitution. Most pesticides/toxicology related graduate students at all of the institutions reviewed for Phase II do receive support in one form or another.

Although student support is often tied to public and private monies, other forms of financial support were mentioned by everyone. They include state instructional grants, state and national student loans, Basic Educational Opportunity Grants, research assistantships, fellowships, and scholarships.

F. EMPLOYMENT

TABLE 13

PESTICIDE/TOXICOLOGY EMPLOYMENT PROFILE - SUMMARY

Degree	Private Sector				
	Industry	Consulting	Combined*	Government	Other
Certificate/ Diploma	80%	10%		10%	
Associate	75%	6%		7%	12%
Bachelors	45%	1%	3%	31%	20%
Masters	42%	11%	1%	31%	15%
Doctorate	29%	9%	4%	27%	31%

*Refers to industry and consulting figures collectively in the instances where sources did not break them down.

Table 13 shows the employment data of graduates from the twenty-four institutions visited that offer degrees with coverage of pesticides and/or taxicology. Figures were provided by faculty members and were either actual statistics or "best estimates"

Contact persons were asked to choose from twenty-three pesticides related or toxicology related occupations, indicating those which they concider their graduates qualified to fill. They were also asked to provide any additional occupational titles which they considered to be appropriate. In some cases, students are qualified to fill many positions which they do not enter historically. The occupations most often cited were:

Degree Level	Occupational Titles
Associate	Pesticide Applicator Pest Control Operator/Inspector/ Monitor/Technician
Bachelors	Entomologist* Insect Rearing Specialist* Epidemiologist Environmental Monitoring Specialist*
Masters	Pest Control Monitor* Regulatory Specialist Pest Control Consultant
Doctorate	Teaching- Extension/University Research- Regulatory Supervisor/Specialist

*Refers to both the Bachelors and the Masters Qualifications.

POTABLE WATER SUMMARY

THE FOLLOWING PAGES PRESENT AN OVERVIEW, IN SUMMARY FORM, OF BOTH VOLUMES OF THE POTABLE WATER REPORT. WHILE THE SUMMARY SYNOPSIZES THIS ENVIRONMENTAL AREA, INTERESTED READERS ARE ENCOURAGED TO REFER TO BOTH POTABLE WATER VOLUME I AND POTABLE WATER VOLUME II FOR A MORE IN-DEPTH PRESENTATION OF THE PROGRAMS.

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POTABLE WATER

A. STATES, INSTITUTIONS, PROGRAMS AND DEGREES

Potable Water Volume I and Potable Water Volume II include 101 postsecondary programs from 33 states. In all, 77 institutions are represented in these volumes. The programs vary in size and in description from operator training at the local level to advanced degree programs offered within the universities. Degrees offered by the institutions, and presented in the two volumes in the program summaries, are represented as follows:

TABLE 14

POTABLE WATER PROGRAM DEGREE OFFERINGS

Program Degree Offerings	Percent Represented In Potable Water Volumes	States
Certificate	5%	
Diploma	2%	
Associate Degree	14%	
Bachelors Degrees	5%	
Masters Degrees	17%	
Environmental Engineer Degree	1%	
Multiple Degree Programs		
Certificate/Diploma/Associate	4%	
Associate/Bachelors	4%	
Bachelors/Masters	9%	
Bachelors/Masters/Doctoral	12%	
Masters/Doctoral	27%	
		California, Colorado, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Missouri, Montana, Nebraska, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Virginia, West Virginia, Wisconsin, Wyoming
TOTAL		33

The multiple degree programs are presented in Potable Water Volume II. The preponderance of these multiple degree programs include bachelors, masters and doctoral degrees, and masters and doctoral degrees programs. In Volume II these two types of multiple degree offering programs comprise 73% of the summaries.

B. ENROLLMENT STATISTICS AND GRADUATES

Program recruiting techniques are as numerous as the programs themselves. The most widespread form of recruitment is by means of distribution of brochures or posters with tear-off cards. Programs at all levels, find this to be a most effective method of advertising. The majority of program personnel interviewed report excellent student response to these methods.

In addition to brochures and posters, community colleges and technical schools actively solicit students through career orientation day programs, high school visitations, mass mailings to area high school teachers and even newspaper ads. These techniques seem to be most effective. Results indicate that over 30% of the students enroll as a direct result of active recruitment. Personnel employed in the field are also actively recruited for certification programs and upgrading seminars, through brochures sent to state associations and other employment sites as well as direct mailing to operators.

Undergraduate recruitment closely parallels that of community colleges. Admission offices often send representatives to high schools and community colleges to recruit students for the institution rather than for a particular program. Within the institution, students are recruited for specific programs.

A majority of contact persons, associated with engineering programs, expressed concern with the difficulty in attracting well qualified undergraduate students to masters and doctoral programs because of the high salaries offered by the private sector to the baccalaureate graduates.

Potable Water Volume I includes 42 programs in which the student origin predominately (87%) is characterized as in-state. Approximately 22% of the programs report 100% of the students as originating from within the state. It is noted that 6% of the programs did not report the student origin. Of the 23 states represented in Potable Water Volume I, five reported foreign students. These states have identified, within the represented programs, foreign student enrollments of from 10% to 20%.

In-state student origin also is predominately reported in Potable Water Volume II. Of the degrees offered, 65% identify at least 50% of the students as originating from in-state, with 2% reporting 100% from within the state. Out-of-state students in excess of 50% are reflected by 28% of the degree offerings. Of the 28 states represented in Volume II, 14 report the presence of foreign students, ranging from 5% to 33%.

The majority (55%) of the programs included in the two potable water volumes, enroll from three to 20 full-time students, although full-time enrollment includes as few as one and many as 530. No part-time students are reported by the majority of the programs included in the two volumes (56%), although as few as one and as many as 500 part-time students were identified.

Table 15 presents the enrollment profile summary for both potable water volumes. The majority of the full-time students presented in these volumes are enrolled in associate, certificate and bachelors level programs. The preponderance of part-time students are enrolled in certificate and masters degree programs.

TABLE 15

POTABLE WATER ENROLLMENT PROFILE SUMMARY

Degree	Enrollment Full-Time	Enrollment Part-Time	Average # Per Year	Graduate Change By Program Up	Down	Stable
Certificate	212	1,041	108	1	0	3
Diploma	110	0	55	0	0	2
Associate[1]	347	39	26	9	1	3
Bachelors[2]	217	4	24	2	0	3
Masters	154	283	19	5	2	6
Env. Eng.	3	0	2	0	0	1
Doctoral[3]	0	0	0	0	0	0
TOTAL	1,043	1,367	234	17	3	18

[1] Does not include Miami-Dade Community College for which figures were unavailable.

[2] Does not include University of Rhode Island and Illinois Institute of Technology for which figures were unavailable.

[3] Does not include Rutgers University, Renssalear Polytechnic Institute, and University of Rhode Island for which figures were unavailable.

Graduates per year range from zero (3% of the programs) to 185. Approximately 52% of the programs are characterized by from one to ten graduates per annum, while 22% reported from 11 to 20 graduates annually.

Approximately 13% of programs reported in excess of 21 graduates per annum, while information was not available for 10%.

A review of the table entitled "Potable Water Enrollment Profile Summary" shows that 47% of the programs presented in the potable water volumes are characterized by program personnel, as stable regarding graduates and enrollments. A slight downward trend is indicated in 8% of the programs, while 45% reported increasing student enrollment and number of graduates. The programs reporting significant increases are at the associate degree level. The masters programs also indicate slight growth and expansion. In part, this may be due to the national trend which is characterized by increasing numbers of adults returning to postsecondary institutions for further academic and/or skill training.

Graduate placement and follow-up were a major area of interest on the part of the project staff. Few program personnel were able to provide data other than entry level information regarding graduates. Alumni associations, annual departmental mail surveys, personnel offices and personal contacts were the most numerous means employed to place graduates and to track post-graduation employment. Overall, 70% of the programs utilize some form of graduate follow-up. The remaining 29% do not have a follow-up procedure and 1% of the programs were unable to supply the information.

C. FACULTY

The faculty represented in the potable water volumes totals 1,082 persons. Of the total, 802 or 74% are reported as full-time, and 280 or 26% are reported as part-time. No attempt was made to develop a faculty-student ratio. A ratio of this nature was deemed less than

meaningful for several reasons which include the fact that some faculty are engaged primarily in research or in adminsitration. In addition, some faculty were not cost-centered through the department and/or some were responsible for an overload (additional courses).

Most of the faculty members interviewed belong to professional organizations and are involved in research activities. Several persons were represented on national boards and task forces, and are well known contributors in the areas of pollution control and abatement.

D. CURRICULA

Programs that address the educational needs of students at the certificate/associate degree level, are structured in similar fashion. Chemistry, biology and microbiology, along with fundamental instruction in water treatment plant operations, compose the core of the majority of programs described in the potable water volumes. Although requirements and electives vary with each program, the majority (58%) at this level, require an internship which usually involves work in a treatment plant.

The preponderance of the baccalaurate programs presented in the two volumes are included in civil or environmental engineering departments. Course work includes strong emphasis on the physical and natural sciences. Core requirements usually include courses in design, operation and maintenance of water treatment plants, water (and wastewater) analyses, environmental health, and applicable environmental engineering.

Graduate level curricula complements the undergraduate programs. Graduate students acquire a more in-depth understanding of design and operation of water treatment and supply facilities through rigorous

course work and research. Time constraints imposed upon an educational institution in order to add a new course or implement a new program vary depending upon the nature of the program. If additional faculty, funding or equipment are needed, five years may elapse prior to approval. However, the majority of programs are able to implement a program change within one year, while replacements are usually implemented within one semester. State universities, for the most part, have limitations on number of faculty and students and, therefore, must replace rather than add programs. Community colleges and technical schools, often, must develop curricula before offering new programs. In such cases, program approval may take up to two years.

While the majority of schools can add a program within one year, and a course within a semester, it may take three years for the changes to appear in the catalogue. New programs and courses are often quite innovative and experimental and, demonstration of need and success may be prerequisite to official status. A new program which is an outgrowth of an existing program with expanded scope, is usually approved more easily, because the need and the faculty have been established.

E. RESEARCH FUNDING AND SOURCES OF STUDENT SUPPORT

Research funding and student support play a vital role in the quality of education at the majority of institutions visited. Research money comes from a variety of sources, both public and private. Federal agencies such as the U. S. Environmental Protection Agency, National Science Foundation, National Institute of Health and the Army Corps of Engineers, support a substantial amount of research at most of the major universities. State and municipal agencies also contribute a significant

amount of money for research activities at local institutions. Private industry research grants and private consulting contracts generate the majority of funding from the private sector.

Community colleges and technical schools traditionally receive very little research funding because they are training rather than research oriented. Occassionally EPA, a state or local agency will allocate funds for upgrading existing programs, community education, or further training for employed treatment plant operators.

The majority of research grants and contracts are directed toward graduate level research and often support both faculty and graduate students. Student support is often dependent upon the number of acquired research grants. The majority of graduate students receive financial assistance in the form of research assistantships, teaching assistantships or graduate fellowships. Clearly, the number and the amount of EPA training grants is declining. This decline often severely impacts post-secondary programs.

Undergraduate students in need of financial assistance often receive general financial aid packages which may take the form of university grants, basic educational opportunity grants, loans, and college work-study. A majority of the students (reflected in the water volumes) receive financial aid at private institutions, while undergraduate students at state supported universities are meeting their financial responsibilities without outside assistance.

F. EMPLOYMENT

Table 16 illustrates the employment profiles in summary, for the two potable water volumes, and includes the students presented

in these volumes. While students graduating from certificate and associate degree level programs predominantly enter public sector employment, the graduates of bachelors, masters and doctoral degree programs enter the private sector. The reason, reported by the major number of program personnel, was salary level. Although the federal wage scales are more in line with the private sector, historically, state and local governments are not always able to meet this economic challenge.

TABLE 16

POTABLE WATER EMPLOYMENT PROFILE SUMMARY

Degree	Private Sector Industry/Consulting		Total	Government	Other
Certificate	38%	1%	39%	61%	-
Diploma	59%	21%	80%	18%	2%
Associate	31%	4%	35%	65%	-
Bachelors[1]	36%	29%	65%	32%	3%
Masters[1]	31%	28%	59%	37%	4%
Env. Eng.	8%	41%	49%	33%	18%
Doctoral[1]	22%	39%	61%	29%	10%

[1]Does not include Illinois Institute of Technology for which figures were unavailable.

At present, the student follow-up network does not readily provide for the categorization of the institution's graduates into distinct vocational roles. Although specific entry level positions are often known, most institutions limit their graduate occupational profiles to "government", "industry", and "consulting". The following listings, however, are the result of program personnel selections of 28 water and wastewater related occupations. Of the programs represented in the volumes at the

certificate, diploma or Associate level, the majority of graduates are trained for the following occupations:

- Engineering Aide
- Industrial Waste Inspector
- Superintendent - Water & Sewer Systems
- Water Treatment Plant Operator

A Bachelors program, in most cases, graduates students prepared to enter the above and, in addition, the following occupations:

- Environmental Engineer
- Sanitary Engineer
- Chemist
- Aquatic Biologist

At the graduate level, most students find employment with private consulting firms or governmental agencies as Environmental Engineers. In addition, students enter the following occupations:

- Water Resource Engineer
- Superintent/Supervisor - Waterworks
- Health Physicist

Graduates of doctoral programs often enter university positions. Summarizing the occupations, graduates of less than four year institutions usually find employment with a municipal or private water/wastewater treatment plant as operators. It is through promotion and continuing education that these people advance to higher level positions. Graduates of these programs have little difficulty in finding employment.

Students with bachelors degrees often return to school for a masters degree after a few years of employment. Those employed with advanced degrees are predominantly products of Environmental or Sanitary Engineering programs. The majority of graduates find employment in their field of study and have a great opportunity for lateral movement.

RADIATION SUMMARY

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RADIATION

A. STATES, INSTITUTIONS, PROGRAMS AND DEGREES

Examined in Phase II of the National Environmental/Energy Workforce Assessment were twenty-five academic radiation training programs which are located in fourteen states. Training programs contacted ranged from certificate level programs offered by such institutions as Memphis State University and the Oak Ridge Associated Universities, to advanced degree programs offered by engineering, public health and science oriented schools. It was not possible to contact all radiation training programs offered by colleges and universities but the study attempted to include a representative sampling of the radiation training programs which are now being offered to students at academic institutions. Most (15) of the institutions contacted offered multiple degrees and whenever possible, descriptions included information on all degree levels.

Table 17 depicts the number of programs surveyed by degree:

TABLE 17

RADIATION DEGREES, PROGRAMS AND STATES

Degree	Number of Programs	States
Certificate	2	Connecticut
Associate	6	Florida
Masters	2	Georgia
Multiple Degree Programs		Kansas
Associate/Bachelors	1	Maryland
Associate/Bachelors/Masters/ Ph.D.	1	Massachusetts
Bachelors/Masters	1	Michigan
Bachelors/Masters/Ph.D.	6	Missouri
Masters/Ph.D.	6	New Jersey
		New York
		North Carolina
		Oklahoma
		Pennsylvania
		Tennessee
TOTAL	25	14

B. ENROLLMENT STATISTICS AND GRADUATES

A wide variety of recruitment techniques are employed by academic institutions to attract prospective students to their programs. Twenty-two programs provided information describing thirty-seven different types of recruitment techniques that they employ. Nine programs did not consider it necessary to recruit students because their programs are well known in this field and consequently they receive more applications than they can accept. Many of the others sent recruitment information packets to inquiring students and to undergraduate programs and high schools. Others replied principally upon high school and community college visitations.

Mostly in-state students are enrolled in Associate and Bachelors degree programs; at the masters degree level, out-of-state students, including foreign students, predominate in radiation enrollments. Radiation programs with long-standing reputations such as at Rensselaer or Rutgers, for example, tend to attract a greater number of out-of-state and foreign students for advanced degrees. Graduate students are attracted by the financial aid and the research facilities offered by graduate programs in radiation training.

Of twenty-seven programs responding to requests for information on graduate follow-up, twenty (74%) had some method of following up where their students were obtaining employment. Newsletters, mail surveys and alumni meetings were the means most often employed to keep current graduate lists.

Table 18 describes the enrollment profiles combined of all of the programs included in the survey:

TABLE 18

RADIATION ENROLLMENT PROFILE SUMMARY

Degree	Enrollment Full-time/Part-time		Graduates Average # Per Year	Graduate Change by Program Up/Down/Stable		
Associate	299	44	131	2	3	3
Bachelors	680	9	148	3	0	5
Masters	401	101	181	9	0	8
Doctoral	119	24	55	3	1	7
TOTAL	1499	178	515	17	4	23

C. FACULTY

A total of 207 full and part-time faculty members serve the twenty-seven radiation training programs described in this volume. Approximately 72 percent, or 160, are full-time and twenty-eight percent, or 63, are part-time. In many of the programs, a variety of departments supply faculty to teach occasional specialty courses from time to time.

Most faculty members consider sponsored research projects to be an excellent way to stay current with the changing techniques and technology in this field. Most are members of professional associations and attend meetings and conferences which are held. Occasional consulting activities are also considered to be an excellent way to stay current in this field and to stay cognizant with changing applications of techniques to solve problems which arise in everyday activities of the nuclear power industry.

D. CURRICULA

At the associate level, students are introduced in many of the programs described in this volume to principles of health physics,

instrumentation and other aspects of applied engineering technologies. Nuclear technicians are principally concerned with the detection, measurement and analysis of sources of both ionizing and non-ionizing radiation. Baccalaureate students in this field of engineering or science are directly concerned with the release, control and safe utilization of nuclear energy. Undergraduate programs are normally intended to prepare students for industrial employment, government service and graduate study. Advanced degree candidates are provided greater opportunities for study involving fundamental research, industrial applications, and community health aspects of radiation protection. Graduate students may specialize in radiation protection topics which involve radiation effects in materials, reactor safety, radioactive waste management, and environmental measurement. Applied study terms are a very active and integral (though not usually required) part of many of the radiation training programs. Summer internships are occasionally also offered at such places as Brookhaven National Laboratory at Long Island, New York. In the radiation area, 14 of the 27 (52%) programs offer work-study.

Forty degree programs were asked for information concerning the flexibility of how courses and programs can be changed. Included are responses from fifteen (63%) of the twenty-four institutions contacted. Of forty degree programs, seventeen (43%) said that it took between one month to one year to implement course content changes, and between one to two years to implement content changes in a program.

E. RESEARCH FUNDING AND SOURCES OF STUDENT FINANCIAL SUPPORT

The radiation programs included in this study receive a diversity of funding and the most common sources are the Department of Energy

(Energy Research and Development Administration and the Nuclear Regulatory Commission), the National Science Foundation, and the Electric Power Research Institute.

Students receive support from federal grant and loan programs, graduate teaching and research assistantships, training grants, internships and other forms of employment, and other sources to assist them in defraying their educational expenses. Graduate teaching and research assistantships were most often cited as the major financial assistance source by nine programs (39%). Internship and co-op programs are utilized by seven institutions (30%).

F. EMPLOYMENT

Table 19 depicts employment data of graduates from the twenty-five institutions visited that offer degrees in the radiation field. Figures were provided by faculty members and were often estimates or based on results of formal follow-up studies.

TABLE 19

RADIATION EMPLOYMENT PROFILE SUMMARY

Degree	Private Sector Industry	Private Sector Consulting	Combined	Government	Other
Associate	27%	6%	33%	65%	2%
Bachelors	42%	11%	53%	28%	19%
Masters	28%	10%	39%	30%	31%
Doctoral	17%	10%	27%	31%	42%

Faculty of the institutions contacted were asked to provide occupational information indicating those which they felt their graduates were qualified to fill. The occupations most often cited were:

Degree Level	Occupations
Associate	Health Physics Monitor, Health Physics Technician, Radiologist Technician.
Bachelor	Radiological Health Specialist, Radiation Physicist, Radiation Inspector, Nuclear Instrumentation/ Control Technician.
Masters	Radiation Biophysicist, Health Physics Monitor, Medical Radiation Physicist, Radiation Engineer, Radiological Health Specialist
Doctoral	Medical Radiation Physicist, Radiation Physicist, Radiological Health Specialist.

SOLID WASTE SUMMARY

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SOLID WASTE

A. STATES, INSTITUTIONS, PROGRAMS AND DEGREES

Educational programs in solid waste management offered by 16 schools in 9 states were surveyed during Phase II. As some schools offer more than one program, a total of 18 programs through which 44 certificate or degree sequences are available were included. Two programs that have been discontinued are discussed because their content and fate are of significant relevance to the field. Programs included represent associate through doctoral work.

Table 20 depicts the number of programs surveyed by degree:

TABLE 20

SOLID WASTE DEGREES, PROGRAMS AND STATES

Degree	Number of Programs	States
Associate	2*	
Bachelor	2	Connecticut
Masters	3	Iowa
Certificate (Masters Level)	1	Michigan
		Missouri
Multiple Degree Programs		New York
Certificate/Associate	1*	North Carolina
Bachelor/Masters	2	Pennsylvania
Bachelors/Masters/Doctoral	4	Tennessee
Masters/Doctoral	5	West Virginia
TOTAL	20	9

*one no longer operable

B. ENROLLMENT STATISTICS AND GRADUATES

The most common recruitment technique is distribution of brochures on posters with tear off cards. Many programs, particularly at the

graduate level, depend heavily upon university-wide recruitment and subsequent transfer to the program. Recruitment of students for associate and operator certificate programs will remain exceedingly difficult as long as mandatory education and/or certificate requirements are not imposed.

Only four programs (all graduate level) have foreign students enrolled. In-state undergraduate enrollments characteristically exceed 80% of the total. The graduate level profile is extremely variable, ranging from an out-of-state low of 10% to a high of 90%.

Table 21 represents the enrollment profiles of the solid waste programs surveyed during Phase II:

TABLE 21

SOLID WASTE ENROLLMENT PROFILE SUMMARY

Degree	Enrollment Full-time/Part-time			Graduates Average # Per Year	Graduate Change by Program Up/Down/Stable		
Certificate	0		50	50	0	0	1
Associate	8		0	2	0	1	0
Bachelors	1,614		15	369	6	0	2
Masters	305	217[1]	152	183	10	0	13
Doctoral	51	2[1]	4	13	0	1	2
TOTAL[2]	1,978	219	221	617	16	2	18[3]

[1]No breakdown was available as to full-time/part-time distribution.
[2]Enrollments are for programs and are not specific to students pursuing solid waste sequence options.
[3]Not all programs responded to this question.

Caution should be employed in interpretation of the above table. Enrollment figures for programs within engineering departments often represent total departmental enrollment and are not, therefore, an

accurate reflection of the actual number of students with a concentration or equivalent in the solid waste sequence. Thus, the total solid waste management enrollment of 2,418 is an inflated figure which gives the appearance of the area being more dynamic than it is. Although respondents in Phase I stated explicitly that the greatest need in solid waste management is for persons trained at the operator/landfill manager level, only two extant programs in this report are of that type. Two others included are no longer functioning due to lack of students and support.

Ten of the 18 operable programs conduct some graduate follow-up although most have no information beyond the first job accepted. Informal word-of-mouth and formal program or department mail surveys are the most common proceedures.

C. FACULTY

Most programs in this sample depend wholly or largely upon faculty who are full-time within the program. Three programs are fairly evenly divided between full-time program personnel and persons based in other departments; three depend wholly, or nearly so, on other department-based faculty designated as part-time with regard to the solid waste program.

Overall, 116 (48%) faculty are full-time in programs with solid waste sequences; 124 (52%) are part-time. This ratio is somewhat distorted because the three programs which depend heavily upon other department based faculty are large, faculty-wise, totaling 97 persons (78% of all part-time program faculty.)

D. CURRICULA

The curricula of solid waste educational programs reflect the current national emphasis in solid waste management as delineated in the Resource Conservation and Recovery Act of 1976. Reduction of solid waste volume,

safe disposal of hazardous wastes, resource recovery, and waste-based power generation are major components of curricula at all levels.

The programs surveyed are evidence that we are preparing people in a variety of aspects of solid waste management but only as a part of a larger field of study. What appears to be most slighted in our approach is a concerted effort to train a competent workforce for jobs requiring less than a bachelors level education.

The bulk of the programs in the report are integral parts of established engineering programs or are multidisciplinary efforts which were generated in engineering departments.

Only three programs indicated internships or applied study terms are integral components of the curriculum. As they are quite different in emphasis no comparison could be drawn among the three, nor could they be contrasted with the other programs.

Curriculum flexibility, in terms of time required to implement course and program sequence changes, appears to be typical of most academic areas. All course changes can be implemented within a year (most in time for inclusion in the next term.) The majority of program sequence changes can be implemented in a similar time frame.

There appears to be little concern for additional material needs. One respondent stated such available material is outdated. Others expressed desires for laboratory hardware and computer software for training purposes.

Respondents in engineering programs generally agreed that communication skills are a problem with students entering the program; a few stressed that this is definitely not so for their students. Many felt that required or elective course work which provide ample opportunity for practice and improvement are limited.

E. RESEARCH FUNDING AND SOURCES OF STUDENT FINANCIAL SUPPORT

Data from Phase II indicate that the most prevalent form of financial assistance to graduate students is through research funding support. Research assistantships and project employment are common. Such support is available through grants provided by such federal agencies as the Environmental Protection Agency, National Science Foundation, National Institute of Health, and the Army Corps of Engineers. State and municipal support is substantial.

Student support includes several sources and types traditionally available to people regardless of major and some which are unique to or of more than usual significance to solid waste education. University-wide scholarships are quite common, as are student loans. The work-study program is a common source of income; most undergraduate students find summer employment.

F. EMPLOYMENT

Table 22 shows employment data for graduates of the institutions visited which offer certificates or degrees with solid waste management sequences. Figures were provided by faculty members and were either "best estimates" or actual statistics collected.

Graduates of most of the programs find employment in the private sector at a rate of 60 or 70%. Graduates of programs for which there is specific information fill consulting positions at a rate significantly greater than that for industry. Overall, public sector employment is less likely for persons with undergraduate degrees than for those with graduate degrees.

TABLE 22

SOLID WASTE EMPLOYMENT PROFILE SUMMARY

Degree	Private Sector Industry/	Combined*/	Consulting	Government
Certificate	40%	-	-	60%
Associate	40%	-	40%	20%
Bachelors	11%	34.5%	15.8%	38.7%
Masters	17%	24%	28%	31%
Doctoral	17%	23.5%	22%	37.5%
Graduate	10%	36%	19%	35%

*Several programs were unable to separate the private sector employment into the Industry/Consulting categories.

Respondents were provided a list of solid waste related occupations. They were asked to indicate positions their graduates are qualified to fill and to add appropriate occupations. The occupations most often cited were:

Degree Level	Occupation
Certificate	Recycling Operator Sanitary Landfill Equipment Operator Sanitary Landfill Operator
Associate	Landfill Operating Manager Solid Waste Management Technician
Bachelors, Masters, Doctoral (No breakdown available.)	Environmental Engineer Environmental Engineering Technician Sanitary Engineer Pollution Control Specialist Solid Waste Systems Manager Public Health Sanitarian Inspector/ Engineer Land Use Planner Environmental Control Technologist Environmental Monitor Specialist

WASTEWATER SUMMARY

THE FOLLOWING PAGES PRESENT AN OVERVIEW, IN SUMMARY FORM, OF BOTH VOLUMES OF THE WASTEWATER REPORT. WHILE THE SUMMARY SYNOPSIZES THIS ENVIRONMENTAL AREA, INTERESTED READERS ARE ENCOURAGED TO REFER TO BOTH WASTEWATER VOLUME I AND WASTEWATER VOLUME II FOR A MORE IN-DEPTH PRESENTATION.

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WASTEWATER

A. STATES, INSTITUTIONS, PROGRAMS AND DEGREES

The two wastewater volumes (Wastewater Volume I and Wastewater Volume II) detail 105 postsecondary programs from 33 states. There are 88 institutions represented in the two volumes. The environmental programs included in the volumes, range from operator training at the local level to advanced degree programs offered within the unversities. The reader is advised that the report was presented in two volumes due to the extensive number of programs summaries included in the environmental area of wastewater. Wastewater Volume I contains all single degree programs, the majority of which are associate and masters degrees. These degrees make-up 66% of the programs included in this volume.

The multiple degree programs are presented in Wastewater Volume II and are represented as: bachelors, masters, and doctoral degrees; and masters and doctoral degrees.

Table 23 reflects the two volumes and the types of degrees offered by participating institutions.

TABLE 23

WASTEWATER PROGRAM DEGREE OFFERINGS

Program Degree Offerings	Percent Represented In Wastewater Volumes	States
Certificate	10%	California, Colorado, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Missouri, Montana, Nebraska, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Virginia, West Virginia, Wisconsin, Wyoming
Diploma	2%	
Associate Degree	18%	
Bachelors Degree	5%	
Masters Degree	12%	
Environmental Engineering Degree	1%	
Multiple Degree Programs		
Certificate/Diploma/Associate	4%	
Associate/Bachelors	3%	
Bachelors/Masters	9%	
Bachelors/Masters/Doctoral	12%	
Masters/Environmental Engineer/ Doctoral	24%	
TOTAL		33

B. ENROLLMENT STATISTICS AND GRADUATES

Table 24 summarizes enrollment figures from all of the participating institutions in the two wastewater volumes.

Full time enrollment in the certificate programs ranges from four to 185. However, only one of those programs has a full-time enrollment of 185 while the remainder report from four to 40 students. Approximately 46% of the programs indicate zero full-time students and 8% were unable to supply the information. Overall, only 13% of the total students enrolled in certificate programs are full-time, while 87% are part-time. Part-time enrollment, at the certificate level, ranges from three to 500. Conversely, of the total number of students enrolled in

diploma programs, 97% are reported as full-time. At the associate level, 97% of the total baccalaureate students are categorized as full-time. At the graduate level, 64% of the total masters level students are full-time and 96% of the doctoral students are full-time. Clearly the associate and masters level programs illustrate the highest percentage of part-time students. Graduates per annum range from less than one to as many as 185.

Overall, 54% of the programs presented in the wastewater volumes are identified as stable regarding enrollment and graduates. An increase was reported by 27% of the programs, while only 8% are characterized by a slight downward trend. It is noted that 11% of the programs were unable to supply the information.

TABLE 24

WASTEWATER ENROLLMENT PROFILE SUMMARY

Degree	Enrollment Full-Time/Part-Time		Average # Per/Year	Graduate Change by Program Up/Down/Stable		
Certificate	229	1,168	236	1	0	5
Diploma	111	3	58	0	0	4
Associate[1]	541	70	14	7	2	11
Bachelors[2]	2,163	67	44	11	3	13
Masters	1,257	714	25	23	6	29
Env. Eng	3	0	2	0	0	1
Doctoral[3]	271	14	3	7	2	18
TOTAL	4,575	2,036	382	49	13	81

[1] Does not include Miami-Dade Community College for which figures were unavailable.

[2] Does not include Illinois Institute of Technology and University of Rhode Island for which figures were unavailable.

[3] Does not include Rutgers University, Renssalear Polytechnic Institute and University of Rhode Island for which figures were unavailable.

C. FACULTY

Total faculty, as depicted in the two wastewater volumes, include 1,106 persons from the 88 institutions visited. Full-time faculty comprise 73% (802 members); and, part-time faculty compose the remaining 27% (304 members). The majority of the faculty members interviewed, devote time and effort to research activities, consulting and/or advisory committees, in addition to their respective program responsibilities.

Full-time faculty members are usually defined as "cost-centered" (supported through the department). Although these persons are involved in research activities, their major support is not dependent upon the availability of contracts and grants. However, part-time faculty are often supported as a direct result of research monies. In addition, part-time personnel may teach only one course per semester.

No attempt was made to develop a faculty-student ratio. A ratio of this nature was deemed less than meaningful for several reasons, which include: some faculty are engaged primarily in research or in administration; a variety of departments supply faculty for occasional courses; and, some faculty members are responsible for teaching overloads (additional courses).

Many faculty members interviewed are defined as prestigious representatives of their environmental area. The majority of these persons maintain memberships in a variety of professional organizations. Many of those professionals interviewed are represented on national advisory committees and have achieved renowned reputations as major research contributors to their fields.

D. CURRICULA

A number of similarities in program structure (including curricula) may be noted upon review of the programs included in the wastewater volumes. At the certificate/associate degree level, general courses in chemistry, math and biology plus fundamental instruction in wastewater treatment plant operations, usually make-up the core in the majority of programs. Many of the certification and diploma programs are upgrading programs for persons already employed in the field. The associate degree programs, for the most part, train personnel to enter the field and require hands-on experience in treatment plants.

Programs at the baccalaureate level are predominately components of civil or environmental engineering departments. For the most part, these programs require a strong background in physical and natural sciences, and tend to emphasize the degree of rigour reflected in the traditional engineering programs.

Graduate level programs generally interface and complement the undergraduate programs. However, more flexibility and often a wider variety of course offerings, allow for the specialization required at this level.

In order for programs to be responsive to changing needs of students and society, flexibility is the amount of time needed to implement a new course and/or to add a new program. Most institutions can add a new course within one semester. Programs which do not require additional funding or manpower can usually be established within one year. Community colleges usually are able to implement these changes more quickly than colleges and/or universities.

E. RESEARCH FUNDING AND SOURCES OF STUDENT FINANCIAL SUPPORT

Research funding and student financial support is derived from a variety of sources, both public and private. The U.S. Environmental Protection Agency provides a substantial number of research grants to most of the major institutions. It was noted that both the number and the amount of these funds, however, is declining. Most program personnel also reflected upon the decline in training monies, especially at the community level.

The majority of the research funding was reportedly channeled toward graduate level research, and often is characterized as a major part-time faculty support mechanism. Student support or assistance is often dependent upon the number of acquired research grants and contacts. Financial aid for graduate students was mainly identified in the form of research assistantships. The undergraduate level financial assistance usually takes the form of the traditional financial aid packages. It was observed that at least one-half of the students attending private institutions (in wastewater programs) were receiving some form of financial assistance.

F. EMPLOYMENT

Table 25 illustrates the employment profiles, in summary, for the two wastewater volumes, and includes only the students reflected within these volumes.

TABLE 25

WASTEWATER EMPLOYMENT PROFILE SUMMARY

Degree	Private Sector Industry/Consulting		Total	Government	Other
Certificate[1]	36%	1%	37%	63%	-
Diploma	59%	21%	80%	18%	2%
Associate	30%	4%	34%	65%	1%
Bachelors	37%	29%	66%	31%	3%
Masters[2]	32%	28%	60%	35%	5%
Env. Eng.	8%	41%	49%	33%	18%
Doctoral[3]	31%	27%	58%	22%	20%

[1]Does not include Stevens Institute of Technology for which figures were unavailable.

[2]Does not include New Jersey Institute of Technology for which figures were unavailable.

[3]Does not include Rensselaer Polytechnic Institute for which figures were unavailable.

The table illustrates the percentage of graduates entering employment in the private sector and the public sector. For the most part, graduates of less than four year institutions predominantly enter public secotr employment. As reported, 63% of the graduates from wastewater certification programs enter positions in the public sector, usually as wastewater operators or technicians. Similarly, associate degree programs report 65% of their graduates entering the public sector. While only 18% of students from diploma programs are reported to enter the public sector employment, this figure may be skewed by the relatively small number of programs represented.

Graduates of bachelors, masters and doctoral degree programs tend to enter private sector employment. The major reason reported, is higher salary levels. Active recruitment by private companies on college

campuses tends to influence the number of qualified students entering the private sector, historically, state and local governments are unable to meet this economic challenge.

Graduate follow-up is often a useful means of evaluating one's programs. The majority (72%) of institutions visited, report some form of graduate follow-up. For the most part, program personnel were able to describe the most frequently entered occupations by the graduates. Occupations listed below are a result of selection from 28 wastewater related occupations.

Programs represented at the certificate, diploma or associate degree level report graduates entering the following occupations.

- Engineering Aide
- Industrial Waste Inspector
- Water Analyst
- Water/Wastewater Treatment Operator
- Safety and Sanitary Inspector

At the baccalaureate level, employment includes the above and in addition, the following occupations:

- Environmental Engineer Water Pollution Control
- Sanitary Engineer
- Chemist
- Aquatic Biologist

At the graduate level, most students find employment with private consulting firms or governmental agencies as Environmental Engineers. The majority of students enter the following occupations:

- Environmental Engineer
- Water Resources Engineer
- Supervisor-Wastewater
- Water Pollution Control Biologist
- Sanitary Engineer
- Superintendent-Water and Sewer Systems
- Health Physicist

The reader is cautioned to remember that job descriptions vary from on level to the next. Therefore, an occupation may occur at both the

associate and graduate level such as "Superintendent-Water and Sewer Systems" but job responsibilities will differ.

Students of doctoral programs often enter university positions which were not listed as one of the occupational choices.

Graduates of less than four year institutions usually find employment with a municipal or private wastewater treatmetn plant as operators. It is through promotion and continuing education that these people advance to higher level positions. Graduates of these programs have little difficulty finding employment.

Students with bachelors degrees often return to school for a masters degree after a few years of employment. Those employed with advanced degrees are predominantly products of Environmental Sanitary Engineering programs. The majority of graduates find employment in their field of study and have a great deal of lateral movement.

COMPOSITE SUMMARY

THE FOLLOWING PAGES PRESENT AN OVERVIEW, IN SUMMARY FORM, OF BOTH VOLUMES OF THE COMPOSITE REPORT. WHILE THE SUMMARY SYNOPSIZES ENGINEERING/HEALTH AND EDUCATION/ECOLOGY PROGRAM AREAS, INTERESTED READERS ARE ENCOURAGED TO REFER TO BOTH COMPOSITE VOLUME I (ENGINEERING/HEALTH) AND COMPOSITE VOLUME II (EDUCATION/ECOLOGY) FOR A MORE IN-DEPTH PRESENTATION OF PROGRAMS.

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COMPOSITE II REVIEW COMMITTEE
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The Composite category accomodates those programs whose focus, structure, curriculum content, and specialized options indicate an overlapping emphasis in two or more environmental areas surveyed in Phase II or whose emphasis is environmentally related but not specific to any one area. This category is further divided into Engineering/Health and Education/Ecology sections; the former reflects a more technological emphasis while the latter integrates coursework in the natural, physical, and social sciences. This conceptual split in the composite category was intended to generate a more interpretable data base; however, the differences between the two sections are not substantial.

A. STATES, INSTITUTIONS, PROGRAMS, AND DEGREES

The Post-Secondary Education Profile (Phase II) surveyed 93 Engineering/Health programs in 32 states and 37 Education/Ecology programs in 17 states. In total, these programs represent a wide spectrum of degree offerings--from the diploma to the doctorate--and curriculum options. Given that 49 of the 93 institutions included in the composite sections offer more than one degree and 16 offer more than one environmental program, any list of schools surveyed in the Post-Secondary Inventory quantitatively represents many more curriculum opportunities than it suggests. The following table lists the number of programs surveyed by degree in the Composite category. For purposes of this summary, the Engineering/Health and Ecology/Education programs are combined.

TABLE 26

COMPOSITE DEGREES, PROGRAMS AND STATES

Degree	Number of Programs	States	
Certificate (graduate level)	1	Alabama	Massachusetts
Diploma	1	Alaska	Michigan
Associate	12	Arkansas	Minnesota
Bachelors	38	California	New Jersey
Masters	18	Connecticut	New York
Environmental Engineering	1	Delaware	North Carolina
		District of Columbia	Ohio
Multiple Degree		Florida	Oklahoma
Cert/Asso/Bach/Mast/Doct	1	Georgia	Pennsylvania
Associate/Bachelors	2	Indiana	South Carolina
Bachelors/Masters	11	Iowa	Tennessee
Bachelors/Masters/Doctoral	15	Kansas	Texas
Masters/Doctoral	29	Kentucky	Utah
Masters/Doctoral/Engineer	1	Louisiana	Virginia
		Maine	Washington
		Maryland	West Virginia
			Wisconsin
TOTAL	130		33

B. ENROLLMENT STATISTICS AND GRADUATES

National summaries of enrollment and graduates per annum for the Composite programs surveys are reported in the following table. These data indicate that approximately three-fifths (58%) of the graduates in the Composite programs are awarded degrees at the bachelors level. The relative scarcity of sub-baccalaureate programs may in part be due to the four-year program requirements normally mandated in engineering and teacher training programs. Enrollment statistics indicate that 54%

of the Composite programs are experiencing stable enrollment and 34% are sustaining growth.

Percentages of in-state/out-of-state/foreign students show a fairly linear increase by degree level. That is to say, graduate programs have higher numbers of out-of-state and foreign students than undergraduate programs. This result is not surprising if one considers the capacity of the graduate programs--with their research facilities and tuition remission and assistantship plans--to attract students from a wider geographic radius.

TABLE 27

COMPOSITE ENROLLMENT PROFILE SUMMARY

Degree	Enrollment Full-time	Enrollment Part-time	Graduates Average # Per Year	Graduate Change by Program Up	Down	Stable
Diploma	14	0	8	0	1	0
Associate	329	70	138	3	4	6
Bachelors	6,206	376	1,586	32	3	24
Masters	1,567	660	905	21	8	42
E.E.	4	12	9	0	1	1
Doctoral	279	76	104	10	5	31
TOTAL	8,399	1,194	2,750	66	22	104

Recruitment techniques are relatively standard across these composite programs and include posters, brochures, visits to local high schools, and campus career days. Those programs with extensive facilities, traineeships, or other curricular or financial attractions find

such inducements facilitate recruitment. The effectiveness of any one method is difficult to assess across programs and is undoubtedly the function of many intervening variables.

C. FACULTY

A total of 992 (62%) full and 610 (38%) part-time members serve the 130 composite training programs surveyed. Of these, 832 (68%) full and 383 (32%) part-time faculty are associated with engineering/health programs and 169 (43%) full and 227 (58%) part-time faculty are working in education/ecology programs. In several programs, a number of departments supply faculty to teach various courses in the composite programs.

When asked how they remain current in their field, faculty responses were largely the same--journals, professional meetings, and consulting. A number of contact persons noted the difficulty of keeping abreast of the rapid changes in the environmental field and observed the need for periodic, easily obtainable up-dates on environmental research and regulations.

D. CURRICULA

Programs in the Engineering/Health section prepare students in at least two of the eight environmental areas surveyed in Phase II (air, energy, noise, pesticides, potable water, radiation, solid waste, and wastewater). The emphasis of the programs is primarily technical and/or scientific and, as reflected in the section heading, geared to environmental engineering and environmental health coursework. The Education/Ecology programs train students for social, educational, political, ecological, managerial, and systems positions within the environmental

workforce. The curricular emphases of both sections are not easily isolated, and the assignment of programs to a particular section is subjective.

Curriculum flexibility, as measured by the amount of time needed to implement a new course or program, gives some indication of the capacity of the educational community to meet changing employment needs. In response to questions regarding this flexibility, contact persons reported that new courses can usually be implemented in one month to one year while program changes may take slightly longer. Answers to these questions were often conditional and dependent on the availability of faculty time and financial resources, departmental and institutional support, and the preparation readiness of course syllabi and materials.

Contact persons made several comments on existing curriculum materials and suggestions for improving instructional aids. They noted that training materials are often "too specific or too general" or "too sophisticated for two-year training programs." Contact personnel asked for curriculum aids that integrate Environmental Studies subjects, more visual aids, and more laboratory equipment. There is some concern that some equipment purchased with federal grant monies must now be returned to the government upon completion of the grant, thus limiting the continuation of research projects.

A concern of professionals in the environmental workforce is that graduates are weak in communication and financial management skills. Engineering/Health and Education/Ecology program personnel surveyed in Phase II basically agree with this assessment but argue that the same concern applies to all students regardless of discipline. Programs typically require some communication training (writing and speaking) in

both formal and informal settings. Financial management skills are usually developed in less structured ways than actual coursework, and according to some contacts, are not necessary prerequisites for sub-managerial employment.

To provide students with a practical working experience related to their classroom and laboratory training, 29% of the Engineering/Health and 59% of the Education/Ecology degree programs offer internships or applied study terms. These experiences not only prepare students for real-world employment but may facilitate job placement. Salaries paid for work under these instructional programs are also a means of financial aid.

E. RESEARCH FUNDING AND SOURCES OF STUDENT FINANCIAL SUPPORT

The financial stability of environmental programs is often a key to their success or demise. Monies for research and student financial aid enable programs to attract faculty and students. Federal and state agencies, private corporations, regional study commissions, and other entities provide important research funding to many of the programs surveyed in Phase II. Curriculum changes, additional faculty lines, laboratory materials, and salary increments cost money; and environmental programs are looking more and more to the federal government for support.

Student financial aid packages typically include scholarships; federal, state, and campus loan programs; college work study; and part-time employment outside the university. A majority of graduate students in many of the programs are employed by their departments as teaching or research assistants or as support personnel on program grants or

contracts. Traineeships, such as those from the Environmental Protection Agency and the National Institute of Occupational Safety and Health, are an important means of support for those programs fortunate enough to receive them; many other contacts note the negative impact the loss of these traineeships has had on the stability of their programs.

F. EMPLOYMENT

Contact personnel were asked what percentage of their program graduates are employed in industry, consulting, government, or other fields (teaching positions, etc.). The following tables summarize these results nationally.

TABLE 28

COMPOSITE EMPLOYMENT PROFILE SUMMARY

Degree	Private Sector Industry	Consulting	Total	Government	Other
Diploma	1%	0%	1%	99%	0%
Associate	32%	11%	43%	54%	3%
Bachelors	34%	12%	46%	42%	12%
Masters	26%	23%	49%	38%	13%
E.E.	58%	11%	69%	27%	3%
Doctoral	27%	28%	55%	31%	14%
TOTAL	31%	16%	47%	41%	12%

Industry and government appear to draw greater numbers of Engineering/Health and Education/Ecology program graduates than do consulting firms and various educational institutions. The high percentage of graduates entering government work is not surprising given the emphasis placed on environmental regulation, assessment, and protection by the public sector. Likewise, government mandates have forced industry to take steps in combating pollution and precipitated employment opportunities in this area. Declines in public school enrollment and fiscal constraints at all levels have contributed to decreasing numbers of jobs in the educational community.

In an attempt to identify more specifically those occupations which Engineering/Health and Education/Ecology graduates are qualified to fill, survey participants were asked to check on a prepared form those jobs that graduates of a given degree are trained to assume. Occupations most often cited were:

Composite

Degree Level	Occupations
Certificate	Air Pollution Control Technician Environmental Monitoring Specialist Regulatory Specialist Sanitary Technician Solid Waste Collection Operator Vector Control Specialist
Associate	Biological Technician Environmental Tester/Analyst Sanitary Technician
Bachelors	Ecologist Environmental Engineering (Water Pollution Control) (Water Resources) Environmental Science Technician Industrial Waste Inspector

Masters	Chemist Environmental Engineer (Water Pollution Control) (Water Resources) Pollution Control Specialist Sanitary Engineer
Environmental Engineering	Air Pollution Analyst Air Pollution Control Engineer Environmental Control Engineer Environmental Engineer (Water Pollution Control) (Water Resources)
Doctoral	Aerosol Physicist Aquatic Biologist Bacteriologist Chemist Environmental Engineer (Water Pollution Control) Microbiologist Pollution Control Specialist

BUSINESS & INDUSTRY

AND

TRADE & PROFESSIONAL ASSOCIATIONS

SUMMARY

BUSINESS AND INDUSTRY

TRADE AND PROFESSIONAL ASSOCIATIONS

This portion of the National Environmental/Energy Workforce Assessment describes 64 training programs related to pollution control and abatement, environmental research and resource conservation. The organizations included in this survey represent a variety of businesses, trade and professional associations. In addition, several institutions of higher education are included due to their unique training components. The eight environmental areas surveyed were air, energy, noise, pesticides, potable water, radiation, solid waste and wastewater.

A. A VARIETY OF RESPONSES

A wide variety of organizations responded to this survey including major oil companies, noise consulting/training firms, utility companies, major manufacturers and numerous types of associations. The training done by such a diverse group varies greatly in format, presentation, and, of course, content and scope. A selection of the types of courses and their presentation provide an overview of the more detailed information included in the Report itself. Courses in the private sector include:

-- Seminars conducted in-house which can include workbooks, pre and post tests, and users' manuals like those at Chevron and Pratt Whitney.

-- In-house campaigns using posters, buttons, pamphlets, newsletters and films such as the 3M (Minnesota Mining

and Manufacturing) programs and Scott Paper's Project DIET.

-- Workshops and meetings prior to or during annual membership conventions, such as the Atomic Industrial Forum, Inc. program and the Institute of Noise Control Engineering.

-- Computer modeling programs for noise used in plants and in communities, such as Chevron's.

-- Audio visual training utilizing slides, sound filmstrips, tapes and videotapes such as those produced by the American Chemical Society, NCASI (National Council of the Paper Industry for Air and Stream Improvement) and ADRA (Automotive Dismantlers and Recyclers of America).

-- Correspondence courses such as those provided by the National Water Well Association.

-- Unique Career Development and motivational programs such as the one designed by the Environmental Management Association.

-- Seminars designed for high school students highlighting conservation and environmental awareness conducted by the Arkansas Power and Light Company annually to over 10,000 students.

-- Emergency preparedness seminars and procedures developed by Duquesne Light Company.

-- A wide variety of workshops developed primarily for the membership in associations such as the Portland

Cement Association and the American Public Works Association.

This list includes a few of the interesting and innovative approaches to training sampled in the private sector. The actual program summaries included in the Report provide additional content information and the necessary detail.

In addition to the varied program content and scope, these training programs differed with regard to several variables:

-- length of program--from several hours to several weeks;

-- number of participants--from a few to 10,000 annually;

-- types of media used; types of instructional materials used; instructional methods employed;

-- participation awards--CEUs (Continuing Education Units); college credits; certificates.

Each of these variables is described in table form within the Report, for each training program included.

B. A TRAINING PROGRAM DEFINED

Obviously, the term training program used in this context is defined quite broadly due to the variety of organizations surveyed. Certain criteria, however, did have to be met in order for an organization's training program to be included. These criteria were:

1) The materials associated with the training effort had to be either printed or audio visual. If the program was so informal that no written materials were available describing the content, it could not be summarized for the Report.

2) On-the-job training was included only if it was a formal training program, that is, had some accompanying written or audio visual materials.

3) Training had to be related in some way to one of the eight environmental areas being surveyed: air, energy, noise, pesticides, potable water, radiation, solid waste and wastewater.

4) Training related to energy conservation or resource conservation was considered a viable program for this report.

One or more of these criteria had to be met in order for a program to be included in the Report.

C. THE OBJECTIVES AND THE PROCESS

The objectives as outlined for this portion of the National Environmental/Energy Workforce Assessment are multiple and broadly stated:

1) To solicit responses from the private sector describing their environmentally related training efforts, in order to answer the basic questions of 'who' and 'what kind' of training is being done.

2) To describe these training efforts in brief summary form in order to determine how, with what types of materials and in what depth are people being trained in the private sector.

3) To seek training programs in all eight environmental areas which provide the focus for this entire Report.

4) To provide primary source data on the relationship between academic training in environmental fields and subsequent employment of graduates in those fields.

In order to accomplish these objectives, the following steps were taken.

-- An initial mailing of 375 letters was sent to various businesses, trade and professional associations.

-- The organizations responding in the affirmative, that is, they conduct some training related to one or more of the environmental areas listed in the letter, were telephoned and asked specific questions about their training efforts.

-- Materials describing the training or actual training materials were sent by the organizations for review and summarization.

-- A draft of the program summary describing the organization's training efforts was sent back to the organization for approval prior to publication.

-- Final program summaries incorporate comments and changes suggested by the organizations.

The process described above generally applies to the organizations included in the Report. However, in some cases, on-site visits were made to the organizations' offices and training center.

D. THE RESULTS

The overall response rate to the initial letter was 33 percent for both businesses and trade and professional associations combined. The association response was somewhat greater, 41 percent, than the response from businesses, 28 percent. These responses resulted in the 64 training program descriptions included in the Report. The programs represent a sample of the types of training being conducted in the private sector and while this sample is small it provides very specific information about such training efforts:

-- "Training encompasses specific skills and information, environmental awareness, global issues, resource conservation, health hazards, computer modeling, emergency preparedness, current environmental issues and regulations as well as new technology.

-- The recipients of this training are primarily employed by the private sector but in some cases include high school students, public sector employees and the community at large.

-- The cost of this training is borne by the private sector.

-- The training programs were developed because of a specific need whether the passage of new legislation, the discovery/invention of new technology, a need for conservation or to reduce the risk of pollution.

-- Training or retraining by the private sector versus academic training in environmental fields is the subject of much debate and varying opinions. The controversy over the preparation of individuals for environmentally related positions may be industry-specific but needs further investigation.

A great deal remains to be learned about training in the private sector. This sample attempts to answer some basic questions and in the course, raises more questions.

COMMENTARY

COMMENTARY

Some general comments surfaced during this phase of the National Environmental/Energy Workforce Assessment. The following is a compilation of thoughts from contact people.

- The withdrawal of federal support was consistently mentioned as the factor that was most instrumental in the reduction of the programs and/or the number of students enrolled. Contact people felt that for continual growth in the environmental areas, federal support would need to be forthcoming and consistent.

- Industry and education need to get together to get together to establish internships which give skills priority and also to ensure a commitment that graduates will be hired.

- The Environmental Protection Agency needs to develop training information with a more formalized approach in mind.

- Environmental studies are growing and increasing in number, their actual enrollment is still small. They are more interdisciplinary and have a small number of faculty supplementing their teaching staff from other departments. Contact people see the ability of students of these programs to write impact statements as one of their big strengths.

- New developments (visual aids, textbooks, etc.) need to be brought to the classroom faster.

- Futures of some programs look strong because of mandatory certification (e.g., solid waste).

- It is felt that the Environmental Protection Agency has a bias in support of engineering programs and those more technically oriented and is not supporting other equally (e.g., environmental health).

- The image of most environmental areas is a neutral one on a campus, except for nuclear energy and radiation. This is felt to be because of general student misunderstanding.

- Schools are feeling less of a need to organize their programs by specific environmental areas now that training grants are no longer so plentiful.

- Some graduate programs are noticing that there is a decline in the number of students applying for admission. They attribute this, in particular, to the higher salaries offered by industry. Students then pursue their training on a part-time basis.

- Professional registering (e.g., engineering and radiation) is strongly encouraged and is a bargaining point in employment.

- Tighting budgets limit students enrollment and limit (or freeze) faculty positions also.

- Advisory boards have proven to be very helpful not only from the public relations point-of-view but also for placement of graduates.

- There is much interaction between the community and students often through workshops with a high degree of environmental commitment on the part of a small nucleus of dedicated people.

- Students want to enter fields with jobs and long-term futures. They are skeptical of new areas (e.g., radiation health, environmental health) in which the jobs are not as yet clear cut.

- Students in associate or certificate programs are encouraged to pursue a further degree. It is more marketable.

- Environmental programs are now responding to the energy crisis via the new courses they are introducing.

- Help is needed earlier in a students training on communication skills. It should not be delayed until college, but rather should be handled on the secondary level.

- Applied study/internships are encouraged because of the professional contact that results, the "hands-on" potential and the valuable work experience. They are often considered the most successful part of the program.

- Two year schools are at a disadvantage because facilities, support people and equipment are lacking especially in comparison to large colleges and universities.

- Although placement offices and professors' recommendations are means used extensively for employment, the best over-all tool for finding a job is still student initiative.

- Great concern was expressed at the firm commitment to a program that results when "soft" money was used. More university support was needed.

- Few options exist for student funding on the associate level other than self-sought. Bachelors students find help in scholarships and co-op programs. Graduate students turn to teaching and research assistantships.

- Most successful means of student recruitment nationally has been through posters, journals and professional assessment.

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
AIR	Carnegie-Mellon University	Pittsburgh, PA
	Clemson University	Clemson, SC
	Drexel University	Philadelphia, PA
	George Washington University-NASA	Hampton, VA
	Harvard University School of Public Health	Boston, MA
	Hudson Valley Community College	Troy, NY
	Massachusetts Institute of Technology	Ithaca, NY
	Michigan Technological University	Houghton, MI
	Middlesex County College	Edison, NJ
	Muskingum Area Technical College	Zanesville, OH
	New Jersey Institute of Technology	Newark, NJ
	North Carolina State University	Chapel Hill, NC
	North Dakota State School of Science	Wahpeton, ND
	Northeastern University	Boston, MA
	Ohio State University	Columbus, OH
	Portland State University	Portland, OR
	Prairie State Community College	Chicago Heights, IL
	Purdue University	West Layfayette, IN
	Rensselaer Polytechnic Institute	Troy, NY
	Rutgers-The State University of New Jersey	New Brunswick, NJ
	Springfield Technical Community College	Springfield, MA
	Stevens Institute of Technology	Hoboken, NJ
	Sumter University	Sumter, SC
	Syracuse University	Syracuse, NY
	Temple University	Philadelphia, PA
	The Pennsylvania State University	University Park, PA
	University of Cincinnati	Cincinnati, OH
	University of Delaware	Newark, DE
	University of Florida	Gainesville, FL
	University of Iowa	Iowa City, IA
	University of Kentucky	Lexington, KY
	University of Maryland	College Park, MD
	University of Michigan	Ann Arbor, MI
	University of Missouri-Rolla	Rolla, MO
	University of North Carolina	Chapel Hill, NC
	University of Pittsburgh	Pittsburgh, PA
	University of Tennessee	Knoxville, TN
	University of Texas-Austin	Austin, TX
	University of Washington	Seattle, WA
	University of Wisconsin-Milwaukee	Milwaukee, WI
	Vanderbilt University	Nashville, TN
	Washington State University	Pullman, WA
	Washington University	St. Louis, MO
	West Virginia University	Morgantown, WV
	Yale University	New Haven, CT

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PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
COMPOSITE:	Antioch College	Yellow Springs, OH
	Baylor University	Waco, TX
	Bemidji State University	Bemidji, MN
	California Institute of Technology	Pasadena, CA
	California Polytechnic State University	San Luis Obispo, CA
	Catholic University of America	Washington, DC
	Carnegie-Mellon University	Pittsburgh, PA
	Chattanooga State Technical Community College	Chattanooga, TN
	Clarkson College	Potsdam, NY
	Clemson University	Clemson, SC
	Cornell University	Ithaca, NY
	Delaware Technical and Community College	Newark, DE
	Delgado College	New Orleans, LA
	Drexel University	Philadelphia, PA
	Duke University	Durham, NC
	East Central Oklahoma State University	Ada, OK
	East Tennessee State University	Johnson City, TN
	Evergreen State College	Olympia, WA
	Ferris State College	Big Rapids, MI
	Florida International University	Miami, FL
	Georgia Institute of Technology	Atlanta, GA
	Heed University	Hollywood, FL
	Hocking Technical College	Nelsonville, OH
	Howard University	Washington, DC
	Hunter College	New York, NY
	Indiana University	Bloomington, IN
	Iowa State University	Ames, IA
	Johns Hopkins University	Baltimore, MD
	Kansas State University	Manhattan, KS
	Kirkwood Community College	Cedar Rapids, IA
	Lamar University	Beaumont, TX
	Macalester College	St. Paul, MN
	Massachusetts Institute of Technology	Cambridge, MA
	McNeese State University	Lake Charles, LA
	Miami University	Oxford, OH
	Michigan State University	East Lansing, MI
	Middle Tennessee State University	Murfreesboro, TN
	Morehead State University	Morehead, KY
	Muskingum Area Technical College	Zanesville, OH
	New Jersey Institute of Technology	Newark, NJ
	North Carolina State University	Raleigh, NC
	Northland College	Ashland, WI
	Ohio State University	Columbus, OH

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PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
COMPOSITE: (Cont'd)	Ohio University	Athens, OH
	Oscar Rose Junior College	Midwest City, OK
	OSU Oklahoma City Technical Institute	Oklahoma City, OK
	Polytechnical Institute of New York	Brooklyn, NY
	Princeton University	Princeton, NJ
	Purdue University	West Lafayette, IN
	Raymond Walters General and Technical College (University of Cincinnati	Cincinnati, OH
	Rensselaer Polytechnical Institute	Troy, NY
	Rutgers University	New Brunswick, NJ
	Sam Houston State University	Huntsville, TX
	Sangamon State University	Springfield, IL
	Slippery Rock State College	Slippery Rock, PA
	Springfield Technical and Community College	Springfield, MA
	Stevens Institute of Technology	Hoboken, NJ
	Syracuse University	Syracuse, NY
	Temple University	Philadelphia, PA
	Texas A & M University	College Station, TX
	The Cooper Union	New York, NY
	The Pennsylvania State University	University Park, PA
	University of Alabama	University, AL
	University of Alaska	Fairbanks, AK
	University of Arkansas	Fayetteville, AR
	University of California-Santa Barbara	Santa Barbara, CA
	University of Cincinnati	Cincinnati, OH
	University of Delaware	Newark, DE
	University of Florida	Gainesville, FL
	University of Georgia	Athens, GA
	University of Kansas	Lawrence, KS
	University of Louisville	Louisville, KY
	University of Maine-Orono	Orono, Maine
	University of Michigan	Ann Arbor, MI
	University of Minnesota	Minneapolis, MN
	University of North Carolina	Chapel Hill, NC
	University of Oklahoma	Norman, OK
	University of Pittsburgh	Pittsburgh, PA
	University of Tennessee	Knoxville, TN
	University of Toledo	Toledo, OH
	University of Utah	Salt Lake City, UT
	University of Washington	Seattle, WA
	University of Wisconsin-Green Bay	Green Bay, WI
	University of Wisconsin-Madison	Madison, WI
	Utah State University	Logan, UT

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
COMPOSITE: (Cont'd)	Vanderbilt University	Nashville, TN
	Virginia Polytechnic Institute and State University	Blacksburg, VA
	Washington State University	Pullman, WA
	Western Kentucky University	Bowling Green, KY
	Western Washington University (Huxley College of Environmental Studies)	Bellingham, WA
	West Virginia University	Morgantown, WV
	Yale University	New Haven, CT
ENERGY:	Bluefield State College	Bluefield, WV
	Brigham Young University	Provo, UT
	Carnegie-Mellon University	Pittsburgh, PA
	Columbia University	New York, NY
	Cornell University	New York, NY
	Georgia Institute of Technology	Atlanta, GA
	Hartford State Technical College	Hartford, CT
	Kansas State University	Manhattan, KS
	Lamar University	Beaumont, TX
	Massachusetts Institute of Technology	Cambridge, MA
	Morehead State University	Morehead, KY
	Muskingum Area Technical College	Zanesville, OH
	Oregon State University	Corvallis, OR
	Pikeville College	Pikeville, KY
	Polytechnic Institute of New York	Brooklyn, NY
	Princeton University	Princeton, NJ
	Purdue University	West Lafayette, IN
	Rensselaer Polytechnic Institute	Troy, NY
	Southern Technical Institute	Marietta, GA
	Texas State Technical Institute	Waco, TX
	The Pennsylvania State University	University Park, PA
	University of California-Berkeley	Berkeley, CA
	University of Florida	Gainesville, FL
	University of Kentucky	Lexington, KY
	University of New Mexico	Albuquerque, NM
	University of Pennsylvania	Philadelphia, PA
	University of Tennessee	Knoxville, TN
	West Virginia Institute of Technology	Montgomery, WV
	West Virginia University	Morgantown, WV

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PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
NOISE:	George Washington University-NASA	Hampton, VA
	Georgia Institute of Technology	Altanta, GA
	Massachusetts Institute of Technology	Cambridge, MA
	Memphis State University	Memphis, TN
	North Carolina State University	Raleigh, NC
	The Pennsylvania State University	University Park, PA
	University of Cincinnati	Cincinnati, OH
	University of Pittsburgh	Pittsburgh, PA
	University of Tennessee	Knoxville, TN
	University of Tennessee Center for Health Sciences	Memphis, TN
PESTICIDES:	Abraham Baldwin Agricultural College	Tifton, GA
	Broward Community College	Ft. Lauderdale, FL
	Central Technical Community College	Hastings, NE
	Delgado Community College	New Orleans, LA
	Harvard University School of Public Health	Boston, MA
	Mississippi State University	Mississippi State, MS
	New Mexico State University	Las Cruces, NM
	North Carolina State University	Raleigh, NC
	Ohio State University	Columbus, OH
	Oregon State University	Corvallis, OR
	Rutgers State University of New Jersey	New Brunswick, NJ
	State University of New York at Farmingdale	Farmingdale, NY
	Texas A & M University	College Station, TX
	The Pennsylvania State University	University Park, PA
	University of California-Berkeley	Berkeley, CA
	University of California-Davis	Davis, CA
	University of California-Riverside	Riverside, CA
	University of Cincinnati	Cincinnati, OH
	University of Delaware	Newark, DE
	University of Georgia	Athens, GA
	University of Iowa	Iowa City, IA
	University of Maryland	College Park, MD
	University of New Hampshire	Durham, NH
	University of Pittsburgh	Pittsburgh, PA
	University of Rochester	Rochester, NY
	Utah State University	Logan, UT

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
POTABLE WATER:	Atlanta University Center/Georgia Institute of Technology	Atlanta, GA
	Brigham Young University	Provo, UT
	California State University	Sacramento, CA
	Carnegie-Mellon University	Pittsburgh, PA
	Casper College	Casper, WY
	Central Technical Community College	Hastings, NE
	Clarkson College	Potsdam, NY
	Clemson University	Clemson, SC
	Colorado State University	Fort Collins, CO
	Community College of Denver-Red Rocks	Golden, CO
	Cornell University	Ithaca, NY
	Delgado College	New Orleans, LA
	Drexel University	Philadelphia, PA
	East Maine Vocational Technical Institute	Bangor, ME
	Hudson Valley Community College	Troy, NY
	Illinois Institute of Technology	Chicago, IL
	Iowa State University	Ames, IA
	J. Sargeant Reynolds Community College	Richmond, VA
	Kansas State University	Manhattan, KS
	Kirkwood Community College	Cedar Rapids, IA
	Linn-Benton Community College	Albany, OR
	Manhattan College	New York, NY
	Marquette University	Milwaukee, WI
	Massachusetts Institute of Technology	Cambridge, MA
	Miami-Dade Community College	Miami, FL
	Michigan Technological University	Houghton, MI
	Middlesex Community College	Edison, NJ
	Missouri Southern State College	Joplin, MO
	Montana State University	Bozeman, MT
	Muskingum Area Technical College	Zanesville, OH
	Northeastern University	Boston, MA
	Northern Montana College	Havre, MT
	Ohio State University	Columbus, OH
	Operator Training Center	Murfreesboro, TN
	Oregon Institute of Technology	Klamath Falls, OR
	Oscar Rose Junior College	Midwest City, OK
	Purdue University	West Lafayette, IN
	Rensselaer Polytechnic Institute	Troy, NY
	Rice University	Houston, TX
	Rochester Institute of Technology	Rochester, NY
	Rutgers State University of New Jersey	New Brunswick, NJ
	Southern Illinois University	Edwardsville, IL

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
POTABLE WATER: (Cont'd)	Springfield Technical Community College	Springfield, MA
	Stanford University	Stanford, CA
	State University of New York at Buffalo	Buffalo, NY
	Stevens Institute of Technology	Hoboken, NJ
	Sumter Technical Community College	Sumter, SC
	Syracuse University	Syracuse, NY
	Temple University	Philadelphia, PA
	Texas State Technical Institute	Waco, TX
	The Pennsylvania State University	University Park, PA
	The Pennsylvania State University/ Capitol Campus	Middletown, PA
	Tufts University	Boston, MA
	Ulster County Community College	Stone Ridge, NY
	University of California-Berkeley	Berkeley, CA
	University of Florida	Gainesville, FL
	University of Hawaii	Honolulu, HI
	University of Iowa	Iowa City, IA
	University of Kansas	Lawrence, KS
	University of Kentucky	Lexington, KY
	University of Maine at Orono	Orono, ME
	University of Michigan	Ann Arbor, MI
	University of Missouri-Columbia	Columbia, MO
	University of Missouri-Rolla	Rolla, MO
	University of Nebraska	Lincoln, NE
	University of North Carolina	Chapel Hill, NC
	University of Pennsylvania	Philadelphia, PA
	University of Pittsburgh	Pittsburgh, PA
	University of Rhode Island	Kingston, RI
	University of Tennessee	Knoxville, TN
	University of Texas-Austin	Austin, TX
	University of Wisconsin-Madison	Madison, WI
	University of Wyoming	Laramie, WY
	Utah State University	Logan, UT
	Vanderbilt University	Nashville, TN
	Virginia Polytechnic Institute and State University	Blacksburg, VA
	Water and Wastewater Technical School	Neosho, MO
	West Georgia College	Carrollton, GA
	West Virginia University	Morgantown, WV
	Wytheville Community College	Wytheville, VA

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
RADIATION:	Central Florida Community College	Ocala, FL
	Chattanooga State Technical Community College	Chattanooga, TN
	Columbia University	New York, NY
	Cornell University	Ithaca, NY
	Hartford State Technical College	Hartford, CT
	Harvard University School of Public Health	Boston, MA
	Kansas State University	Manhattan, KS
	Massachusetts Institute of Technology	Cambridge, MA
	Memphis State University	Memphis, TN
	Missouri Southern State College	Joplin, MO
	Oak Ridge Associated Universities	Oak Ridge, TN
	Oklahoma State University	Stillwater, OK
	Rensselaer Polytechnic Institute	Troy, NY
	Rutgers State University of New Jersey	New Brunswick, NJ
	St. Louis Community College at Forest Park	St. Louis, MO
	Southern Technical Institute	Marietta, GA
	The Pennsylvania State University	University Park, PA
	University of Florida	Gainesville, FL
	University of Kansas	Lawrence, KS
	University of Lowell	Lowell, MA
	University of Maryland	College Park, MD
	University of Michigan	Ann Arbor, MI
	University of North Carolina	Chapel Hill, NC
	University of Pittsburgh	Pittsburgh, PA
	University of Tennessee	Knoxville, TN
SOLID WASTE:	Carnegie-Mellon University	Pittsburgh, PA
	Clarkson College	Potsdam, NY
	Cornell University	New York, NY
	Drexel University	Philadelphia, PA
	Hofstra University	Hempstead, NY
	Michigan Technological University	Houghton, MI
	Rensselaer Polytechnic Institute	Troy, NY
	Temple University	Philadelphia, PA
	The Pennsylvania State University	University Park, PA
	University of Iowa	Iowa City, IA
	University of Missouri-Rolla	Rolla, MO
	University of Pittsburgh	Pittsburgh, PA
	Vanderbilt University	Nashville, TN
	West Virginia University	Morgantown, WV
	Wilson County Technical Institute	Wilson, NC
	Yale University	New Haven, CT

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
WASTEWATER:	Atlanta University Center/ Georgia Institute of Technology	Atlanta, GA
	Brigham Young University	Provo, UT
	California State University-Sacramento	Sacramento, CA
	Carnegie-Mellon University	Pittsburgh, PA
	Casper College	Casper, WY
	Central Technical Community College	Hastings, NE
	Charles County Community College	La Plata, MD
	Clarkson College	Potsdam, NY
	Clemson University	Clemson, SC
	Colorado State University	Fort Collins, CO
	Community College of Denver-Red Rocks	Golden, CO
	Cornell University	Ithaca, NY
	Delgado College	New Orleans, LA
	Drexel University	Philadelphia, PA
	East Maine Vocational Technical Institute	Bangor, ME
	Greenville Technical College	Greenville, SC
	Harvard University	Cambridge, MA
	Hudson Valley Community College	Troy, NY
	Illinois Institute of Technology	Chicago, IL
	Iowa State University	Ames, IA
	J. Sargeant Reynolds Community College	Richmond, VA
	Kansas State University	Manhattan, KS
	Kirkwood Community College	Cedar Rapids, IA
	Linn-Benton Community College	Albany, OR
	Manhattan College	New York, NY
	Marquette Technical University	Milwaukee, WI
	Massachusetts Institute of Technology	Cambridge, MA
	Miami-Dade Community College	Miami, FL
	Michigan Technological University	Houghton, MI
	Middlesex County College	Edison, NJ
	Missouri Southern State College	Joplin, MO
	Montana State University	Bozeman, MT
	Muskingum Area Technical College	Zanesville, OH
	New England Regional Wastewater Institute	S. Portland, ME
	New Jersey Institute of Technology	Newark, NJ
	Northeastern University	Boston, MA
	Northern Montana College	Havre, MT
	Ohio State University	Columbus, OH
	Operator Training Center	Murfreesboro, TN
	Oregon Institute of Technology	Klamath Falls, OR
	Oscar Rose Junior College	Midwest City, OK

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
WASTEWATER: (Cont'd)	Purdue University	West Lafayette, IN
	Rensselaer Polytechnic Institute	Troy, NY
	Rice University	Houston, TX
	Rochester University	Rochester, NY
	Rutgers State University of New Jersey	New Brunswick, NJ
	Southern Illinois University	Edwardsville, IL
	Springfield Technical and Community College	Springfield, MA
	Stanford University	Stanford, CA
	State Technical Institute at Memphis	Memphis, TN
	State University of New York-Buffalo	Buffalo, NY
	Stevens Institute of Technology	Hoboken, NJ
	Sumter Technical Community College	Sumter, SC
	Syracuse University	Syracuse, NY
	Temple University	Philadelphia, PA
	Texas State Technical Institute	Waco, TX
	The Pennsylvania State University	University Park, PA
	The Pennsylvania State University/ Capitol Campus	Middletown, PA
	Tufts University	Boston, MA
	Ulster County Community College	Stone Ridge, NY
	University of California-Berkeley	Berkeley, CA
	University of Florida	Gainesville, FL
	University of Hawaii	Honolulu HI
	University of Kansas	Lawrence, KS
	University of Kentucky	Lexington, KY
	University of Lowell	Lowell, MA
	University of Maine at Orono	Orono, ME
	University of Missouri-Columbia	Columbia, MO
	University of Missouri-Rolla	Rolla, MO
	University of Nebraska	Lincoln, NE
	University of North Carolina	Chapel Hill, NC
	University of Pittsburgh	Pittsburgh, PA
	University of Rhode Island	Kingston, RI
	University of Tennessee	Knoxville, TN
	University of Texas	Austin, TX
	University of Wisconsin-Madison	Madison, WI
	University of Wyoming	Laramie, WY
	Utah State University	Logan, UT
	Vanderbilt University	Nashville, TN
	Virginia Polytechnic Institute and State University	Blacksburg, VA
	Water and Wastewater Technical School	Neosho, MO
	West Georgia College	Carrollton, GA
	West Virginia University	Morgantown, WV
	Wytheville Community College	Wytheville, VA